Engineering Record

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Railway Engineering Convention

NEXT week there meets in Chicago in annual convention one of the most useful of American technical societies—the American Railway Engineering Association. Not spectacular in its methods, seldom coming into the limelight, it works on efficiently from year to year, accumulating a mass of tremendously valuable material which is most effective in raising railroad standards throughout the country. It is an example of an association keeping constantly before it the ideal of "service" to its members. Its efforts are governed not by the desire of prestige or public position, laudable as such motives are in an engineering organization, but by the needs of the railroads of the country as represented by the association's membership. It merits and is receiving the hearty support of railroad engineers.

To Confer on Co-operation

NINE national and sixty-seven local engineering societies have been invited, through a committee of which Prof. F. H. Newell is chairman, to meet in Chicago April 13 and 14 to discuss ways and means of co-operation among engineering societies. It is unnecessary for this journal to remark that the need of and desire for co-operation among organizations of engineers have been to the fore in recent years. To rehearse the arguments supporting the co-operative movement is entirely unnecessary. What has long been awaited is some agency through which broad and effective co-operation could be brought about. The opportunity is now offered in the Chicago meeting. No society having the means and truly desirous of working for the best interests of the profession will fail to be represented at Chicago.

Lackawanna Suburban Stations

THE publication as the leading article of this issue of a description of the South Orange improvement of the Lackawanna Railroad affords occasion to call attention to the remarkable group of suburban stations this railroad has built in recent years. All of them are characterized not only by excellence of engineering design and architectural treatment, but by a liberality in the purchase of ground for an adequate setting that speaks volumes for the road's appreciation of what it can do to increase the attractiveness of the communities dependent on it for service. The stranger coming into the handsome stations at Montclair, Morristown, Chatham, Mountain Station and South Orange is sure to get a most favorable first impression of the community. General civic betterment, too, has not infrequently had its beginning in the cleaning up of a rundown railroad neighborhood, centering about a dilapidated station. The stations mentioned, to which Madison and Morris Plains, now under way, must soon be added, have been termed the handsomest group of suburban stations in the country. The railroad's chief engineer, Mr. Ray, and its architect, Mr. Nies, backed by the ample resources and broad policy of the Lackawanna, deserve great credit for the high plane of these developments.

To Local-Association Members

ON page 377 will be found a lengthy editorial discussion of a letter which a past-president of the American Society of Civil Engineers has sent to the society's local associations of members. Those who are fully acquainted with the relationship between the United Engineering Society and the "founder" societies will not be disturbed by his communication, but those not so informed will doubt seriously the advisability of the shift of headquarters. The Engineering Record knows this because one of its editors attended the meeting of a local association when the past-president's communication was read. While before its receipt the association as a whole favored the removal, the letter brought up serious doubts, and the association determined to query the society's headquarters as to the correctness of the assertions. It behooves all members of local associations, therefore, to see that the misconceptions of the communication are not allowed to stand uncorrected. The statements as to the society's relations to the United body, in case of removal to Thirty-ninth Street, are absolutely wrong.

New York's Garbage Problem

NEW YORK CITY'S garbage disposal problem appears to be no nearer solution now than it has been for years past. The Board of Aldermen, in defeating Commissioner John T. Fetherston's project for new works on Riker's Island, outlined in last week's issue, page 349, has completed a cycle whereby the Street Cleaning Department's efforts to install up-to-date equipment and secure a profit for the city from grease recovery are again at the starting point. Of course, the reason for quashing the Riker's Island project was that it would create a public nuisance. This argument found ready support from taxpayers and real-estate interests in the Boroughs of The Bronx and Queens, although Commissioner Fetherston denies that objectionable conditions will result from operating the works at the site selected. In weighing the validity of these objections another factor must be taken into consideration. The city's present contract with the private company which operates the existing garbage reduction plant at Barren Island will expire at the close of this year. Naturally a lucrative agreement such as now exists will not be meekly surrendered by those who are profiting by it. What influence, if any, this factor has had in the rejection of the Riker's Island project can, of course, only be surmised. If all proposals for an up-to-date plant, which will yield a profit to the city, are killed outright or tied up by delays the Barren Island company, even with its antiquated plant, will be the only one in the field when a new agreement becomes necessary.

State Control of Clearances

ILLUSTRATING the activities of state-utility commissions in matters that could perhaps be left pretty much to the railroads themselves, the Minnesota Railroad and Warehouse Commission has recently adopted a clearance diagram for bridges and tunnels. The diagram is compared on page 393 with the standard of the American Railway Engineering Association, and with that rejected by that society last year. While the proposition last year was opposed on the ground that it was unnecessary to increase the standard width from 14 to 15 ft., the Minnesota commission raises it to 16 ft. On the other hand, the Minnesota commission finds 21 ft. vertical clearance sufficient, whereas the railroads have adopted 22 ft., having noted that with 21 ft. trainmen on high cars are still occasionally struck. If Minnesota may decide upon 16 and 21 ft., Iowa may as easily adopt 16½ and 20½, and Wisconsin might be content with 15½ horizontal, but require 22½ vertical. Lack of a uniform standard for fixed structures such as bridges and tunnels, is, of course, not as serious as varying requirements for equipment, especially if the rules are applied only to new structures. Moreover, the railroads are the direct losers if the clearances are insufficient, as rate increases can hardly be made to take care of damage claims. It does seem that the state commissions could safely leave the entire question to the railway organizations, whose committees and other members have given it much thought.

Vicious Highway Legislation

SIX changes in as many years would wreck any organization in the business world. Yet that rate of change is what the New York State Highway Department has had to endure. After much labor and pain the Carlisle regime came in and brought order out of chaos, while its successor has been continuing to work right along the lines laid down by its predecessor. Now, however, comes the Argetsinger bill which proposes to disrupt the whole fabric again and to set it back to where it was years ago. Maintenance work is conceded by highway engineers the country over to be our most important road problem to-day. Now it is carried on in New York under the supervision of the state highway department. Under the proposed law, maintenance would be handed over to the counties to be done as and in the way the county superintendent thought fit. Not over ten of the county superintendents are capable or have an organization to handle the expenditure of the maintenance money efficiently. This system of maintenance was tried out some time ago and proved an absolute failure. Moreover, the bill is in the nature of ripper legislation, taking the present division engineers who are under civil service out of the system and replacing them by politically appointed deputy commissioners, whose required qualifications are so simple that the veriest tyros in highway building could be placed in charge of the state's important highway divisions. The bill is vicious in the extreme. The New York State Highway Department and its troubles appeared frequently in these columns up to about three years ago. Since then conditions have been immeasurably bettered. If the Argetsinger bill goes through, one can look for the return of the good old days when highway work in New York, through disorganization, was a by-word for the grossest inefficiency.

The Mooted Subway Grating

WHEN the present subway in New York City was opened complaints were quickly made about the air. They have waxed with every summer. Despite the fact that thorough analysis, made by Drs. Charles F. Chandler and George A. Soper over a period of three years, showed the subway air to be better than that on New York streets, the complaints have lately been revived, organized and swelled by a small minority of property owners whose vault space has been curtailed by the construction of ventilators on the new routes. These men would have the city pay for installing any ventilating system, however great the cost or little the benefit, that would return to them their vault space. While it is true, as those who read the report (page 382) by the special committee which has just investigated the entire subject will realize, that conditions in New York's subways are radically different from those in the subways of European capitals, requiring positive measures for relief where none are needed or used abroad, it will be apparent also that the objectors have had the utmost consideration shown them.

Although private and public engineers have worked on the problem for years, and many schemes, ranging from the ridiculous to those prohibitive in cost, have been proposed and have received the most careful consideration, the original decision of the engineers in charge of subway design—to ventilate through sidewalk gratings—has been vindicated. There is no relief in sight from some excess of heat over the outside air, except at a price which the city cannot pay. The new subways will otherwise be as well or better ventilated than any places in which men congregate. The only arguments entitled to public consideration that the objectors were able to advance have been answered.

Reproduction Cost Allocated According to Use

ON PAGE 386 the Engineering Record presents an abstract of what it regards as a remarkable appraisal report, that of W. W. K. Sparrow, assistant chief engineer of the Missouri Public Service Commission, on the Mississippi River & Bonne Terre Railway. The report goes into the allocation of investment and expenses between classes of service as does no other report that has come to the attention of this journal, with the possible exception of the Ulster & Delaware report of W. J. Wilgus, abstracted in the Engineering Record of Aug. 21, 1915. The valuation, too, of the whole road deserves careful reading. Reproduction cost, that outlaw among state commissions, is made the basis. Land values above normal market value are allowed in certain cases, being derived by a novel method which Mr. Sparrow holds is consistent with the Minnesota rate case. The Engineering Record is unable to agree with Mr. Sparrow in all of his theories. It is impressed, however, with his evident desire to play fair to both sides—the more so because it contrasts so sharply with the determination of a number of commissioners in neighboring states to shape their theories to produce the lowest figure.

Mr. Sparrow starts with an assumption that his neighbor commissioners say is impossible, but that this journal thinks is entirely reasonable and the only fair one—that everything is present except the railroad itself. He perhaps does not make it clear that he assumes the original configuration of the land, but evidently he must if he is to have any grading.

His treatment of land is somewhat like that set forth by Hammond V. Hayes last November at the valuation conference in Philadelphia (see the Engineering Record of Nov. 20, 1915, page 626). He uses the difference between actual cost and original normal value as a sum to be added, however, instead of deriving from it a basic ratio. He makes no deductions for land donated or bought for one dollar, but allows such at the present market value.

Several objections can be raised to this method. The assumption that in reproduction the same lands would be donated, the same bought at normal value, the same condemned, is rather fine-drawn, and results in some wide ranges in figures allowed for lands of equal normal value, since multiples as high as 12 are found in his report in the prices actually paid under condemnation proceedings. Nor is any account taken of the probability that the $1 consideration recited in the deed in many cases is no index of the price actually paid, which may have been considerably more than the market value. Moreover, the addition of the constant would hardly produce the proper figure for terminal or other land in a large city. For instance, because a tract originally worth $10,000 was bought for $20,000, it does not follow that if its normal value now figures $100,000 it could be obtained for $110,000. One other objection to universal application of the method—perhaps the most serious of all—is the virtual impossibility of ascertaining original normal value along the older Eastern roads. These last two objections do not apply to the road in question, however, which does not reach any large cities, and is not so old as to preclude knowledge of original values. The method, at least, gives the road the benefit of multiples actually paid and of much of the unearned increment, and does not produce a total considerably less than original cost, as the California method does.

A liberal allowance has been made for appreciation, and here again Mr. Sparrow has declined to follow the state-commission line of reasoning. The Engineering Record cannot commend his reason for allowing appreciation, which is that it classes with depreciation. Mr. Sparrow accepts the state-commission view of depreciation, stated by Milo R. Maltbie in Washington last May, and in the estimation of this journal this is Mr. Sparrow's worst error. The Engineering Record sees no inconsistency in allowing appreciation because it makes for cheaper operation and is manifestly an element of value, and then ignoring theoretical depreciation because it does not affect operating expenses and has no effect on value except to impose upon the owners the responsibility of making final renewals as they become necessary.

Coming now to the allocation of items according to use, the report comes as a natural complement of that of Mr. Wilgus, mentioned above. The Wilgus abstract treats mainly of maintenance and other operating expenses. The Sparrow report deals with the investment. It is interesting to note that the two agree that the ton-mile should be the general basis for dividing the accounts, and that freight and passenger traffic can be considered equally destructive per ton-mile. When the Interstate Commerce Commission in its recent decision in the Western passenger-rate case discussed the large number of allocation theories that had been presented to it the Engineering Record suggested the desirability of a perusal of the Wilgus abstract. The perusal of both abstracts is now recommended.

Not the least interesting feature of the Sparrow report is the redistribution of certain of the items to the several lines of the road with their various balances of traffic. This was rendered necessary because the road is small and the lines carrying no passenger traffic are a considerable part of the whole system.

Altogether the report is one deserving careful reading. The road, although small, was well organized and equipped. Even though such an analysis could not perhaps be carried out in a similar way on a larger and more complex property, the report is replete with useful suggestions and is a most worthy addition to valuation literature.

Serious Misconception Regarding the Plan to Move the Civil Engineers' Headquarters

THERE has been sent to the local associations of members of the American Society of Civil Engineers a plea directed against the proposal to move the headquarters of the society to the Engineering Societies' Building. The Engineering Record recognizes the loyalty and pride in the Society's achievements of the past-president who has circulated the appeal. On account of his fervent pleading and his standing as a past officer, the plea is likely to have considerable weight, unless the obvious misconception on which the major part of it is based is pointed out. The gentleman in question does not understand the relationship which exists between the United Engineering Society and the "founder" societies, and which would exist between that body and the American Society of Civil Engineers, should it move to Thirty-ninth Street.

The greater part of the plea rests on the premise that if it moved to the union building the American Society of Civil Engineers would surrender its autonomy, would become a branch of the United Engineering Society, would be unable in future to stand as a free agent before the public and the profession—in short, would be subordinated to the United body. Nothing could be further from the truth. The constitution of the United society provides for and requires nothing of the sort. Moreover, there is the outstanding fact that the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers have for twelve years been members of the United society without being subordinated to it. The United Engineering Society interferes in no way in their affairs. Its purpose and limitation is to own and manage the building in which they are housed, not to usurp or assume the duties of a technical body. It has never stood before the public or the profession in advocacy of any measure, engineering or otherwise; it has never been the spokesman for anything that the electrical, the mechanical and the mining societies wished to accomplish, either individually or collectively. The Engineering Foundation, established as a result of Ambrose Swasey's gift, is organized under the auspices of the United Engineering Society, but is administered by representatives of the four national engineering societies, including the American Society of Civil Engineers.

The following quotation will serve to show the tenor of the main part of the plea:

"Suppose we become an 'additional founder society,' and we desire to put before the public a measure which we have conceived and which we deem important. It must have the sanction of the United Engineering Society, representing the majority of the founder societies, which can prevent action, or, if approved, the United Engineering Society would stand before the public as the sponsor of the measure."

This statement is absolutely wrong. There is nothing in the constitution of the United Engineering Society which obliges any of its member bodies to take up anything with it, except what applies to the building or library management. As a matter of fact, the United society is without power except on building and library matters. The American Society of Civil Engineers would surrender none of its freedom. It would proceed on any subject, professional or otherwise, as it saw fit, just as each founder society does now, without reference to the United body. Furthermore, the societies now forming the United Engineering Society would never consent to the surrender of their rights. Each is as proud of its name and accomplishments as is the American Society of Civil Engineers and insists on maintaining its identity and autonomy. Moreover, any movement would have greater strength if it bore the name, as sponsors, of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining Engineers, than if it were fathered by the United Engineering Society as such.

While it seems entirely unnecessary to say more as to the falsity of the premise on which the main part of the plea rests, one other quotation will show how the membership of the American Society of Civil Engineers may be disturbed if the misconceptions are allowed to stand uncorrected:

"If we do accept the invitation," says the plea, "future national or other movements for the benefit of the profession will be headed by the United Engineering Society, and our share in the work will be merely auxiliary thereto, the ultimate result of which will be that the influence and standing of the American Society of Civil Engineers, which is now conspicuous, will gradually wane, and finally be lost in the controlling organization of which we will become a chapter."

In view of what has been said above, it is apparent that there is no foundation for such a statement. It could only be made in entire ignorance of the charter of the United Engineering Society and of the founders' agreement, to change which in the slightest particular requires the unanimous consent of the mechanical, electrical, and mining engineering societies.

The plea deals with other subjects—with the possibility of co-operation without housing in the same building, with the relative operating expenses on Fifty-seventh Street and on Thirty-ninth Street, with the library, with the comparative trend, downward or upward, of the two properties in question and of their respective neighborhoods, and with the investment the society has in its present house. All these, however, are minor in comparison with the fundamental error, and practically all of them have been discussed in previous issues of this journal.

In the matter of operating expenses, which the plea says would be $2,511 greater on Thirty-ninth Street than on Fifty-seventh Street, the Engineering Record accepts in preference the statement in the unanimous report of the society's own committee of seven, which expressly says that the operating expenses are practically the same. As to the neighborhood, the Engineering Record's own judgment runs strongly counter to that of the plea and coincides with the committee's report. The Thirty-ninth Street, rather than the Fifty-seventh Street site, is in the district with the better future.

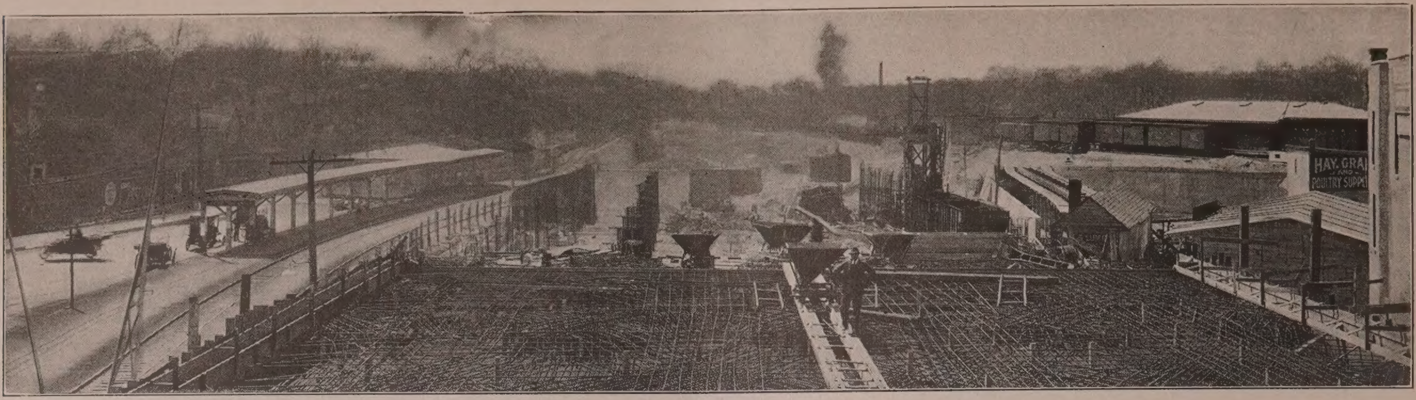
On the matter of the library, the plea says, "If our library, consisting of 86,000 pieces, is turned over to the United Engineering Society, it seems we would lose our property interest therein, and in case we should at some future time decide to dissolve the merger and move elsewhere, the library would be left behind as the property of the United Engineering Society."

The answer to this statement is that it is not true. The library of the civil engineers would continue to be owned by that society, and not by the United Engineering Society, and could be withdrawn later if desired.

On the matter of investment, this sentence is found: "It is stated that our present home, which meets our requirements, cannot be duplicated for less than $475,000, so if it is sold at its appraised value we would lose $150,000, which, added to the $240,000 proposed in the merger, would really make our contribution $390,000 for the privilege of becoming one of the founder societies."

This statement neglects the fact that the property cost the society only $360,000, that the reproduction value is not a measure of present value, and that if the society should move to Thirty-ninth Street it will secure in exchange for the payment of $240,000 an equity worth over $500,000.

But, as stated, these considerations are minor compared to the main issue of the plea—the claim that the American Society of Civil Engineers would lose its identity. Were such the case, the Engineering Record believes that the proposal would never have been put before the membership by the board of directors, and, in fact, would have been indignantly spurned by the committee of the society which considered and reported on the subject. The plea declares that the society would give up its freedom of action, that it would become subordinate to another organization. The statements have not the least foundation in fact. The society's opportunity to do independently for the profession and the public whatever it wishes will not be one whit less than it is now. Instead, through the closer association with the mechanical, electrical and mining engineers, inevitable to the occupancy of the same building, it will have broader and more frequent opportunity to enlist the co-operation of these other bodies on matters where it deems such co-operation to be for the best interests of the society and of the profession. It has now the chance to break down the barrier between the civil engineers on the one hand and the mechanical, electrical and mining engineers on the other, and it can do it without sacrificing anything—its management, its autonomy, its prestige, its financial condition. The separateness of its present house alone would be given up—in favor of a home that, in the opinion of the Engineering Record, is not only equal to but superior to the present quarters.



LOOKING WEST DURING CONSTRUCTION—TEMPORARY TRACKS AND STATION ON LEFT, FREIGHT HOUSE ON RIGHT

"Soo Terminal" Type of Station, Being Built by Lackawanna at South Orange, Nears Completion

Space Problem Solved, in Connection with Track Elevation, by Continuing Bridge Over Avenue as Reinforced-Concrete Viaduct, 426 Feet Long, and Placing Station Underneath

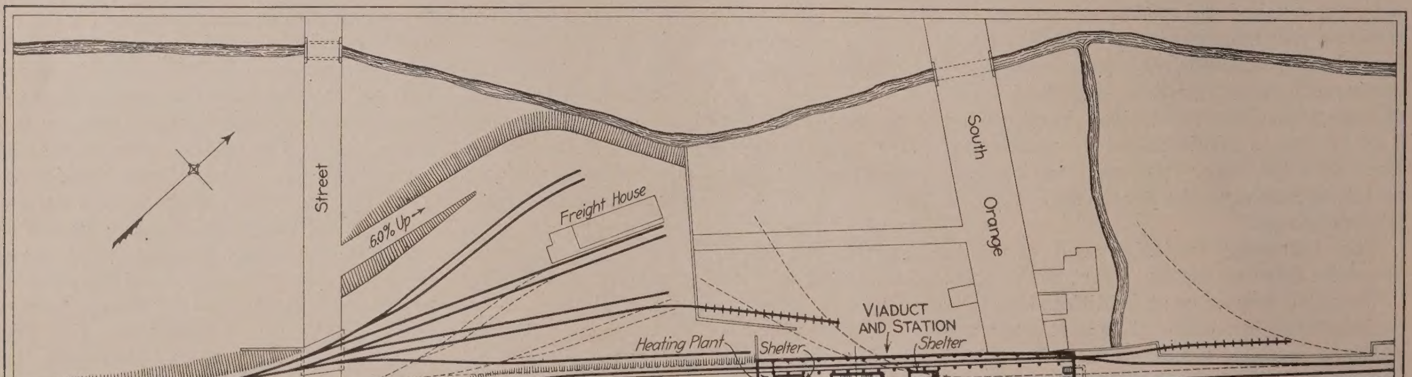
FOLLOWING the high standard the company has set for itself for grade-crossing work in New Jersey, the Delaware, Lackawanna & Western Railroad, in eliminating its grade crossings in South Orange, is putting up structures that will combine beauty with utility. The main feature of this particular improvement is the reinforced-concrete viaduct at South Orange Avenue. The solution of the grade-crossing problem at this point called for the elevation of the tracks, and as the plot of ground west of the avenue occupied by the present station was not large enough to accommodate a station alongside the tracks that would have satisfied the company's standard, the difficulty has been met by extending the bridge over the avenue as a reinforced-concrete viaduct, after the fashion of the Soo Line freight terminal in Chicago, and placing the main part of the station under the viaduct. Other advantages of this design are the provision of ample covered facilities for carriages and autos to accommodate a large number of commuters widely scattered; of a large covered platform for passengers to the street cars on South Orange Avenue, and a ground-floor baggage room and teaming platform under the viaduct structure. In the station the main waiting room and ticket office are on the ground floor, while shelter houses at the track level at once protect those waiting on the platform and give architectural character to the station. While trains have been running over the viaduct since Sept. 29, 1915, the station was not entirely completed until Feb. 1.

South Orange is on the Morris & Essex line of the Lackawanna, which leaves the main line about 2 miles from the Hoboken Terminal, and rejoins it at Denville, N. J., 35 miles west. Through freight traffic goes over the shorter main line, hence the business of the Morris & Essex line is mostly passenger, including a heavy commutation passenger traffic to and from New York. The line has three main tracks, the middle track being operated with the preponderance of traffic, eastbound in the morning and westbound in the evening.

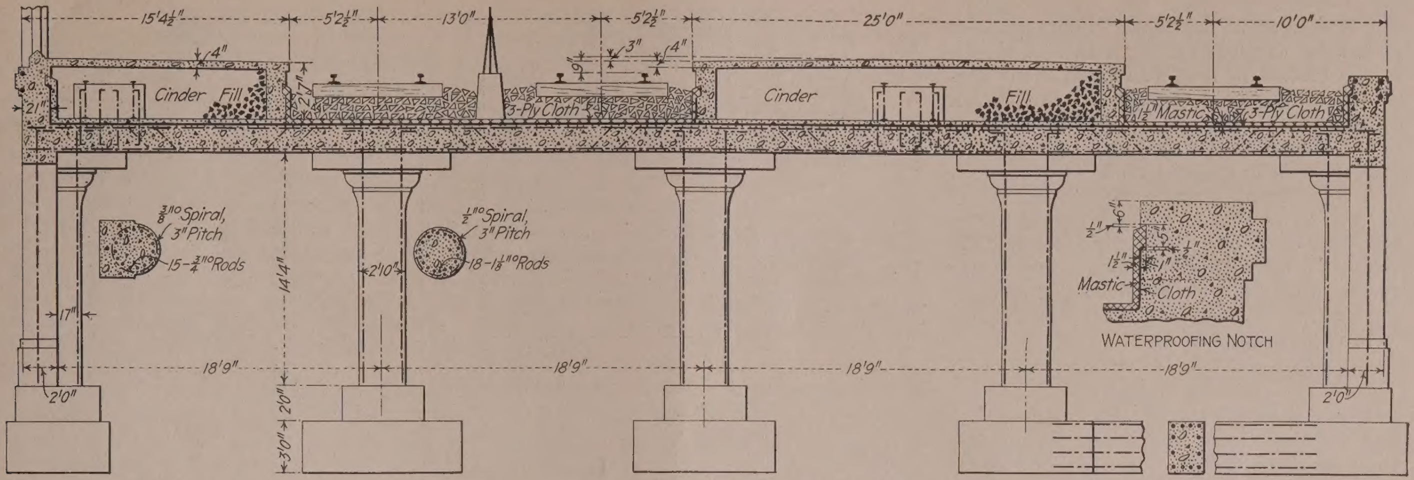
EXTENT OF IMPROVEMENT

The South Orange improvement begins about 4000 ft. east of the station and continues 2000 ft. west. Four grade crossings are eliminated. The most easterly of these crossings, Montrose Avenue, at Mountain Station, has been carried over the tracks without change in the track profile, and this work is no physical part of the work here described. The main improvement begins ½ mile east of the South Orange Station, where the tracks begin to rise on a 0.3 per cent grade, the old profile being descending at about that grade throughout the town. As soon as the viaduct is passed the tracks descend to the old profile on the ruling gradient, 1 per cent. About 1000 ft. east of the viaduct the Mead Street grade crossing is eliminated by lowering the street and bridging it with a typical slab structure. A short distance west of the viaduct the Third Street grade crossing is disposed of in a similar manner. The latter street shows on the general plan.

The general plan shows the location of the South Orange Avenue crossing and the viaduct and station. The viaduct is 426 ft. long and 79 ft. wide. The avenue crossing is at the extreme east end, while the center line of the station is about 130 ft. from the west end. The avenue and the station are connected by a broad walk at ground level,



GENERAL PLAN—TEMPORARY TRACKS AND STATION IN HEAVY DASHES, TRACKS REMOVED IN LIGHT DASHES



TYPICAL TRANSVERSE SECTION OF VIADUCT OUTSIDE OF STATION, AND DETAILS OF COLUMNS AND WATERPROOFING NOTCH

which occupies all of the space under the viaduct except that under the south row of panels, which is assigned to vehicles. The baggage room is at the west end of the station, and has a driveway beyond, while under the extreme northwest corner is the heating plant.

VIADUCT

The viaduct is designed with a uniform spacing of columns, 18 ft. 9 in. on centers transversely and 20 ft. longitudinally, except at South Orange Avenue, where the spacing is distorted in both directions, being adjusted longitudinally to the skew of the avenue and the width of roadway and sidewalks, and transversely to the narrowing of the viaduct to avoid property north of the railroad on the east side of the avenue that could not be acquired at a satisfactory figure. This gives five columns per transverse bent, five fitting the arrangement of tracks, platforms and stair wells without the complications that four would have caused. Longitudinally a wider spacing would have given vehicles on the ground level a chance to get in and turn around between columns instead of having to back in, but it would have required a heavier deck. Furthermore, with the transverse spacing remaining 18 ft. 9 in., the design would have been more uncertain, as comparatively little has been developed as to the theory of four-way reinforcement of slabs other than square or nearly so.

A typical cross-section of the viaduct is shown. Tracks 1 and 2 are on 13-ft. centers. Tracks 2 and 3 are separated by a 25-ft. island platform, while there is a second platform 15 ft. wide on the south side. The slab is uniformly 20 in. for the entire width (except for the longer spans over South Orange Avenue), the variation in stresses being taken care of, as in the case of the columns, by varying the amount of steel. The platforms are independent cinder-filled box structures built on the slab.

WATERPROOFING THE SLAB

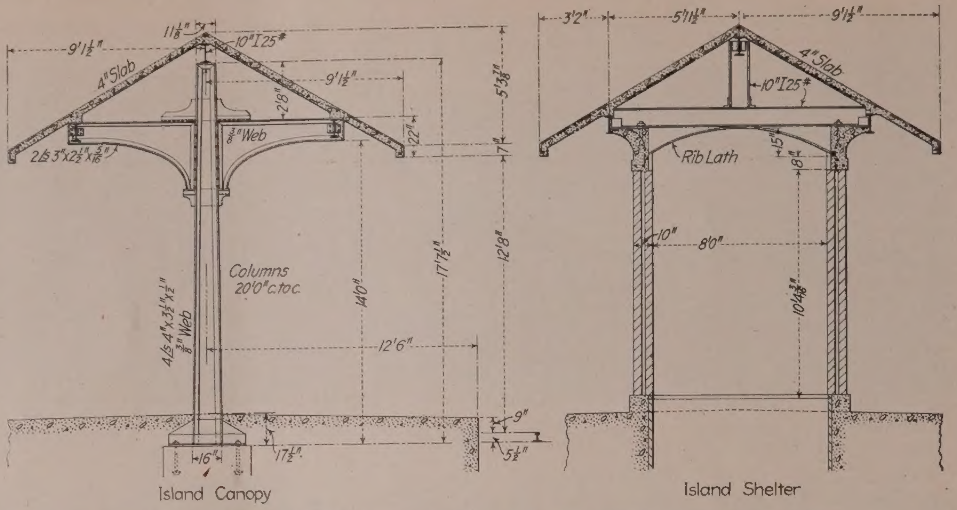
The entire upper surface of the slab is waterproofed with Minwax waterproofing by applying three layers of Minwax cloth mopped with the necessary compound. Under the tracks and at the sides of the adjoining platforms the waterproofing is protected with 1½ in. of asphalt mastic put on in two layers each ¾ in. thick. All that part of the waterproofing extending under the platforms is made in a similar manner, except that it is protected with 1½ in. of cement mortar plastered over the Minwax cloth.

A pleasing exterior for the viaduct was obtained by bush-hammering the surface of the concrete, placing ornamental tile decorations over each column and surmounting the structure with an ornamental railing —this treatment, of course, being supplementary to the careful attention given to the general exterior lines of the viaduct. The general effect of the viaduct is shown in one of the photographs.

FLAT SLAB DESIGN

The cantilever flat-slab system, patents for which are controlled by the Concrete Steel Products Company, of Chicago, consists of a four-way reinforcement for the slab. Approximately one-half of the rods of each band are bent up over the column capitals to provide reinforcement for negative bending moment at these points. The effective depth at the columns is increased by drop panels, which also serve to reduce

DARK-COLORED BRICK STATION FORMS PLEASING CONTRAST TO CONCRETE OF SOUTH ORANGE VIADUCT



ISLAND SHELTER AND ISLAND CANOPY DESIGNED WITH CONTINUOUS ROOF

the shearing stresses. The peculiar condition of loading of the South Orange viaduct, caused by the location of tracks as shown in the section of a typical bent, made certain assumptions necessary in the design of this slab.

The structure was designed to carry two 232-ton Mikado engines (four drivers, 5 ft. 6 in. on centers, with 60,000 lb. axle loads) on each of the three tracks. Owing to the high rate of speed of the trains crossing the viaduct, a large live load impact factor was added, which amounted to 68 per cent of the static live load and was proportioned in the following ratio:

$$I = \frac{L^2}{L + D}$$

The maximum negative and positive live load moments were determined by the theorem of three moments for wheel concentrations of the two engines followed by a train load of 6000 lb. per linear foot of track over seven panels for both the irregular spans over the avenue and the typical panels. For maximum moments all three tracks were considered loaded.

In addition to the longitudinal continuity of the slab over the columns, there is a transverse continuity. However, the moments that were computed in the longitudinal direction were distributed transversely in accordance with the method of computing simple beam reactions and the impact factor determined by the formula mentioned above. Due to the considerable amount of fixedness at the columns and the transverse continuity, 12/15 of the computed moment was used, thus giving end moments equivalent to $wl^2/15$ for determining the amount of steel required over the columns.

Following the method of calculating the negative moment over the columns, the slab at the center of the panel was proportioned for the maximum positive moment, reduced in the same ratio as was the negative moment. The reinforcement required was then distributed among the direct and diagonal bands in accordance with the coefficients of 1/40 and 1/60 respectively, or a ratio of 3 to 2, as established by the Chicago building code.

DESIGN OF COLUMNS

The columns were designed as hooped columns, with both spiral and vertical reinforcement to take the maximum reactions due to the conditions of loading as heretofore described. The footings of the two columns of each bent, under the westbound track, are connected throughout by reinforced-concrete ties to insure a more uniform distribution of the load on these footings. The footings are designed for a soil pressure of 3 tons per square foot on a good gravel subsoil about 5 ft. below the surface of the ground.

The unit stresses used in the design of this work were 650 lb. per square inch for extreme fiber compression in the concrete, 16,000 lb. per square inch for tension in the steel, and 500 lb. per square inch for concrete columns exclusive of the steel reinforcement.

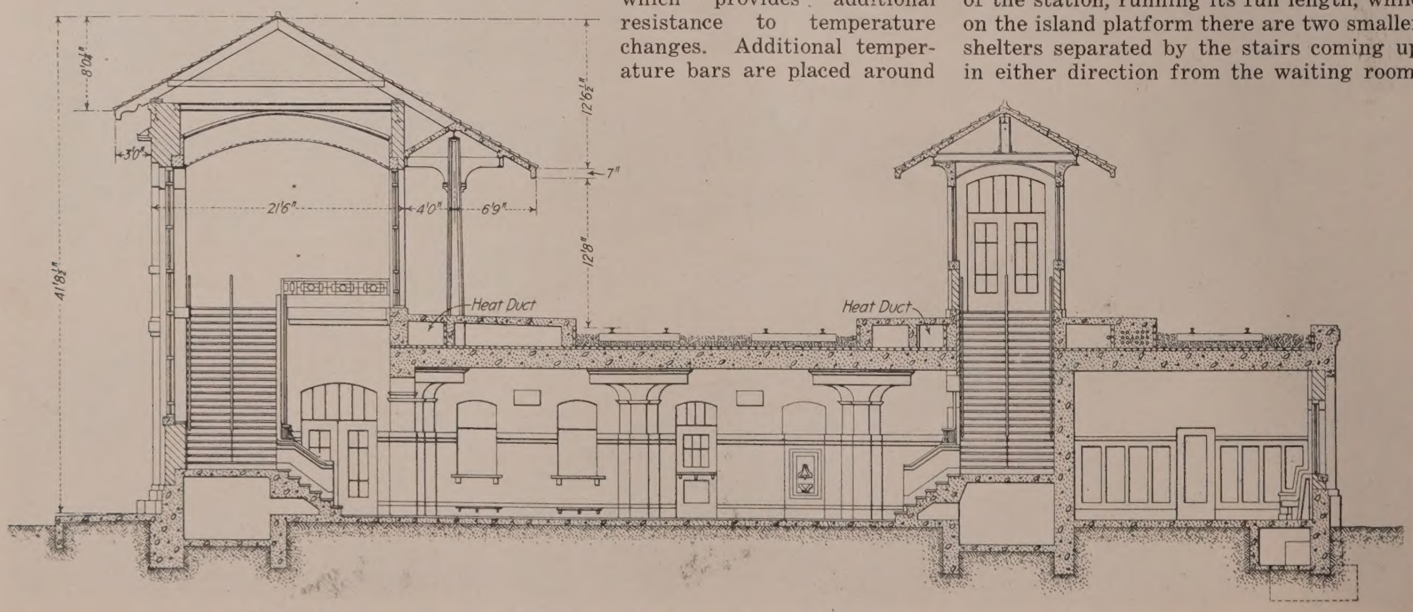
TEMPERATURE REINFORCEMENT

The structure, 426 ft. long, has no expansion joints. The slab is reinforced for stresses due to temperature variations by bands of reinforcing steel between each row of columns, both longitudinally and transversely. There are ten $\frac{3}{4}$-in. rounds in each longitudinal band and seven in each transverse band, spaced uniformly between the drop panels and placed in the upper plane of the slab. The bars of the four-way reinforcement that are not bent up over the columns to resist the negative moment are lapped to furnish continuous reinforcement, which provides additional resistance to temperature changes. Additional temperature bars are placed around the stairway openings to bring the resistance of the reduced section to the same tensile strength as that of the full section.

At the east end there are two stair wells in the last transverse bay. These openings reduce the strength of the bay materially as a tension member, but not to the extent that the same reduction in cross-section would weaken an interior bay, because there is practically free bearing of the slab on the abutment that results in a variable unbalanced pull on the columns. For this reason cracks might be expected to develop from the transverse sides or corners of the stairwells adjacent to the last row of columns. To meet this contingency the drop panel for half its width was extended between these columns, giving a section of increased depth along the sides of the openings, and forming a beam in which extra reinforcing steel was placed. The sliding joint of the abutment was made effective by covering the seat, which was troweled carefully to a level surface, with three plies of cloth laid in asphalt.

STATION

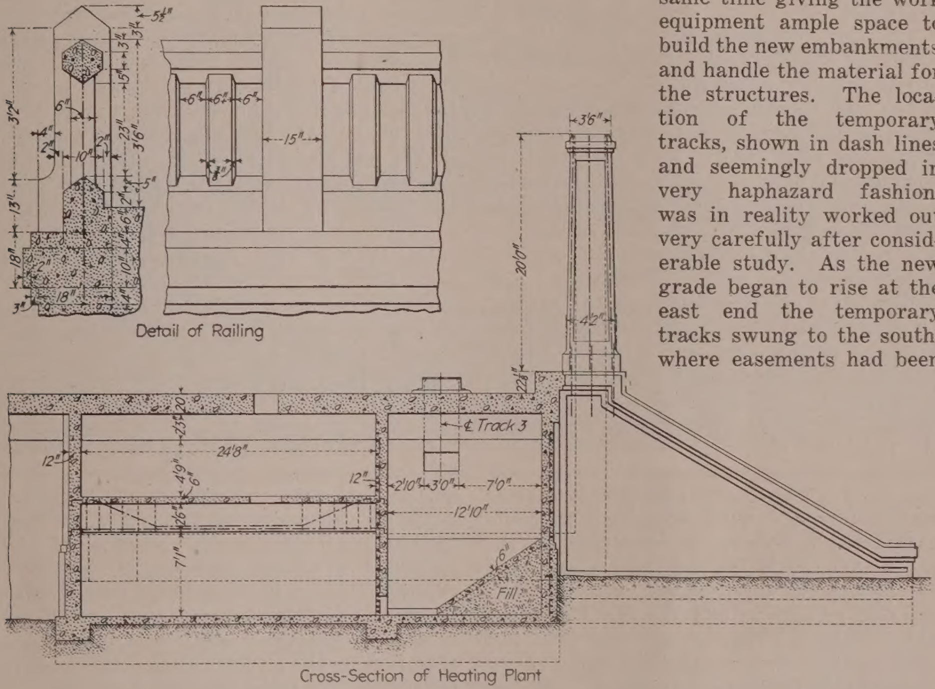
As stated in the first paragraph, the station is laid out with the main elements—waiting room, ticket office and baggage room—on the ground floor, and only auxiliary shelters on the upper level. The shelter on the south side forms the second story of the station, running its full length, while on the island platform there are two smaller shelters separated by the stairs coming up in either direction from the waiting room.



CROSS-SECTION OF VIADUCT THROUGH STATION, GIVING SUGGESTION OF ARCHITECTURAL TREATMENT

Originally it was intended to build the station of concrete to conform best to the viaduct. The architect was asked, however, to see what could be done with brick, and the result is now believed to be more pleasing, as well as less costly, than concrete. The exterior finish is of Bloomsburg wire-cut brick coming in various shades of dark red, the darkest being used as headers to form a sharp contrast. The stretchers are laid in pairs not separated by mortar. Various decorative paneling has been introduced, and the windows are trimmed with ornamental concrete blocks. The roofs are tile. The interior finish is plaster over a buff-colored brick wainscoting.

Among the architectural difficulties encountered in adjusting the brick of the station to the concrete of the viaduct was that of carrying the coping of the latter, which is on a grade, around the station. A horizontal coping at the theoretical elevation at the center line of the station was built along the station, and the adjustments were made by steep grades at the ends of the building.



DETAIL OF RAILWAY AND CROSS-SECTION OF HEATING PLANT UNDER VIADUCT

HEATING PLANT

The station is heated and ventilated by hot-air blast. The heating plant occupies the two north panels next to the west abutment. The housing is entirely of concrete. The chimney is brick, to conform to the station. A cross-section is shown. Coal is dumped from hopper cars into a bin through a hatch under track 3. The furnace and boiler occupy the lower floor of the two-story section, the smoke passing into a flue along the abutment and thence into the chimney at the north end of the abutment. On the upper level is a fan which draws outside air through an opening in the wall and forces it through a steam coil from the boiler, whence it passes, heated, into one of three ducts. One of these is directly under the island platform, and supplies heat for the shelters thereon; the other two are underground, and supply heat for the lower level, and also for the south shelter via a vertical shaft in the ticket office. Another fan and duct draw foul air from the waiting room through openings near the floor.

The canopies are designed to appear so far as possible a part of the station. That on the island platform is continuous as to width, height and slopes with the shelter houses. Cross-sections of the two are shown. The canopy on the south platform is similar to that on the island platform, but narrower.

Access to the platforms is had by the stairways in the station, and also by others at each end of the platforms, those at the east end leading from the east side of South Orange Avenue, and those at the west end from a tunnel in the fill beyond the viaduct at Second Street.

MAINTAIN TRAFFIC DURING CONSTRUCTION OF VIADUCT

The ever-present problem of maintaining traffic during construction was met in the case of this improvement by swinging the tracks to the south, thus avoiding the costly raising of tracks under traffic, and at the same time giving the work equipment ample space to build the new embankments and handle the material for the structures. The location of the temporary tracks, shown in dash lines and seemingly dropped in very haphazard fashion, was in reality worked out very carefully after considerable study. As the new grade began to rise at the east end the temporary tracks swung to the south, where easements had been obtained on unoccupied land and buildings removed to allow the temporary tracks to be placed entirely clear of the proposed fill.

At the east side of South Orange Avenue it was necessary to crowd in to avoid a small store, and from that point the difficulties began. One hundred feet west of the avenue it was necessary to swing out far enough to clear the old station without encroaching upon Sloan Street. It was also necessary to find a site for a temporary station after the old one had been torn down, and this was obtained as shown by leasing property just west of First Street, swinging the tracks back as far as possible to the north and building the small temporary station shown in one of the photographs, permission being obtained from the village to encroach upon Sloan Street to a slight extent with the station platform. Then by leasing and closing up the two tenements on the narrow street connecting First and Second Streets, and moving one of these back to a new foundation, room was found for the two tracks, mostly in the street itself, which the village allowed to be temporarily closed.

Beyond Second Street it became necessary again to lease private land, and also to tear down a small mill and a feed warehouse. Beyond Third Street the temporary alignment swung back to the old alignment. With this temporary location the only parts of the construction interfered with were the wing wall of the west abutment at Third Street and the embankment from that point west. At these points it was necessary to make some quick shifts at the proper time.

One of the photographs suggests the method of handling the concrete work. At first the work was handled from the east end with a mixing plant mounted on a flat car, and the concrete was placed in buggies run on falsework, on a track laid over the steel reinforcement as shown, or on the finished slab itself. Later it became possible to work another mixing plant from the west end. The slab was poured in three operations, the columns being poured first to the underside of the drop panels.

CHANGES IN OTHER FACILITIES

As is likely to be the case with such improvements, the work interfered both with various industries along the line and with the company's own local freight facilities. To take care of the former it became necessary to build three trestles and reorganize the plants they were to serve. In connection with the latter the company seized the opportunity to enlarge and otherwise improve the layout. The company had a reinforced-concrete freight house, 110 x 30 ft., on a site which was suitable for the new layout, which was to be about 7 ft. higher than the old. The company therefore simply removed the roof of the old station, filled between the walls to the new ground level, and built a new station of brick on top of the old. The concrete projects above the ground about 4 ft., just revealing the ornamental work above the old doors.

Hyde, McFarlin & Burke, of New York City, had the general contract for the entire improvement. F. D. Hyde built the station under a separate contract. The material from the embankments was hauled by the railroad from a heavy cut on another grade-crossing improvement being handled by the same contractors at Madison, N. J. The work was carried out under the general direction of G. J. Ray, chief engineer of the Delaware, Lackawanna & Western Railroad, and G. T. Hand, division engineer. A. B. Cohen, concrete engineer, had charge of the concrete design, and F. J. Nies, architect, designed the station. W. H. Speirs, assistant engineer, was in immediate charge of the construction work.

THE FLOOD PROBLEM OF KANSAS is important, according to an assertion made by H. B. Walker, drainage and irrigation engineer of the Kansas State Agricultural College, in a paper presented recently before the Kansas Engineering Society, because more than 2 per cent of the state's most productive area is subject to overflow; because 143 cities and villages representing one-fourth of the state's population are directly affected; because 13.4 per cent of the railroad mileage and 3 per cent of the highways are located in the overflow area, and because the property loss in thirteen years has been approximately $50,000,000. A plan involving twenty-six reservoirs has been proposed by the Union Pacific Railway to handle the Kaw River, and levees have been recommended by the U. S. Department of Drainage Investigations for the Neosho, Cottonwood and Marie des Cygnes Rivers.

Subway Air Exceeds Health Board's Standards, Ventilating Experts Find

Heavy Traffic, Waterproofing and Imposed Condition of Four Tracks in One Bore Responsible for Excessive Heat, Says Report of Engineering Committee

IN OXYGEN content and percentage of carbon dioxide the air of New York City's subways is shown by the results of recent tests to be better than standards adopted by the Board of Health for the air in office buildings, and is said to be practically equal to the air in city streets. In the number of bacteria per cubic meter the subway air was found to be actually superior to the air of the streets. Confirming earlier analyses of the subway air, the tests showing these results, made for a committee consisting of William Barclay Parsons, S. L. F. Deyo, J. Vipond Davies and Lewis B. Stillwell, indicate that the only basis for complaint is the excessive heat generated by train operation. Objections to this heat and the use of sidewalk gratings for ventilating the new subways gave rise to agitation which resulted in the appointment by the Public Service Commission on June 18 last of the committee named to investigate the entire question of subway ventilation. The committee, after considering the methods of ventilating existing subways, including those abroad, concluded that the system being installed in New York City is sufficient for the public health, and that while to improve it for public comfort in summer is desirable, that object cannot be attained without disproportionate expense.

NEW YORK'S SUBWAYS PRESENT NEW PROBLEM

As pointed out in the report of this committee, while the first subway was being constructed in New York other similar lines were put in operation in London, Paris, Berlin and Boston. Some of these were new electric lines, but in the case of two in London former steam lines were converted to electric operation. On none of these lines were the temperature conditions found in New York repeated. Aside from the fact that the climate of New York is warmer than that of the other cities, the high temperature in the New York subway, the committee reports, is due to three causes: First, the much heavier traffic, liberating a greater amount of heat, both from train operation and from the passengers. Second, the fact that the New York subways are necessarily constructed throughout the greater part of their length as a single tunnel section containing four tracks, giving the minimum area of contact with the ground, through which heat could be radiated, in proportion to the number of tracks. Third, the fact that protests based on the fear that foul ground water would find its way into the structure resulted in the complete insulation of the original subway by waterproofing.

SUBWAY AIR GOOD AT PRESENT

In order to ascertain whether in the course of several years' operation there had been any radical change in the air in the subways since the earlier investigations, the committee conducted a series of tests under the supervision of G. L. Lucas, general inspector of the Public Service Commission. Samples of air were taken at a number of places within the subway and at the same time in the open street. The oxygen content was found to vary from 20 to 20.9 per cent, substantiating earlier investigations. The percentage of carbonic acid gas was found to have increased from 5.67 parts in 10,000, as found in earlier analyses, to 6.2 parts in 10,000, which is well below the limit of 10 parts in 10,000 considered by the Board of Health sufficient to require an investigation in buildings where this quantity is found to be present. Only 219 bacteria per cubic meter were found in the subway air as contrasted with 255 per cubic meter found in the street air. The average temperature in the old subway has, however, increased from 5.6 deg. in excess of that of the outside air in summer to 16.76 deg.

RADICAL VENTILATING SYSTEMS PROPOSED

Immediately after its appointment, the committee held public hearings, at which those interested appeared in person or were represented by counsel and engineers, all urging the adoption of some ventilating system that would dispense with sidewalk openings. These suggestions have been grouped by the committee into four classes: First, chemical treatment of the air. Second, control of air currents in the subway by closing station entrances. Third, openings for ventilation in other places than in the sidewalk, and especially the use of chimneys in private buildings for forced draft ventilation. Fourth, refrigeration. As indicated above, the committee found that no chemical treatment of the air was necessary. The suggestions for closing the station entrances with revolving doors were considered impossible of execution, as the enormous crowds that use the subway could not be handled safely except with complete freedom of ingress and egress. Under the third heading, suggestions fell into two groups. The first proposition was for the construction of large ventilation shafts or chimneys at points within the blocks. Experiments with the existing subways convinced the committee that chimneys would not remove from the subway any considerable volume of air unless operated by forced draft. To install such a system, the committee has estimated, would represent a total capitalized cost of $14,000,000 or $2,000,000 per mile of four-track subway, without including private rights or easements. The second class of suggestions under this head contemplated using existing boiler plants for securing the forced draft. In order to secure the necessary draft, the committee states that 50 tons of coal per day would have to be burned in each block. This quantity is in excess of the winter coal consumption, to say nothing of the consumption in the summer when ventilation is needed most. To build boiler plants for this purpose would, of course, be much less economical than other mechanical means of securing forced draft. To connect the subway with only the large plants, such as those in hotels, would be insufficient and would require expensive construction. Furthermore, the connection from the subway would have to be made through the ash-boxes of the boiler plants, or the cold air from the subway would reduce the temperature of the flue gases above the fires so greatly as to put the boiler plants out of operation. Besides the probability of rushes of air interfering with economical operation of the plants, or forcing gases out to the boiler room, there is the danger that, even with mechanical equipment, fire gases would be drawn back into the subway through the ducts leading to the boiler plants by the suction of the trains.

REFRIGERATION IMPRACTICABLE

The committee states that the fourth class of suggestions goes to the root of the trouble, but that to carry any of them out would entail prohibitive cost. The average quantity of heat per hour per foot of subway liberated through train operation and from the passengers is 935 B.t.u, and the maximum amount produced in one hour was found to be 2380 B.t.u. It was concluded from these figures that those plans proposed for refrigeration which were estimated by their advocates to be possible at a reasonable cost would lower the temperature in the subways only 2 or 3 deg. Fahr. Furthermore, all of these estimates are stated to be insufficient as regards the allowance for operating cost and not to provide sufficient plant for ventilation purposes. Also, refrigeration in the climate of New York would result in the condensation of a great deal of moisture within the subway, which would cause endless trouble with the electric operating equipment. Such difficulties have already been experienced in the operation of the North River Tunnel of the Hudson & Manhattan Railroad.

SUBWAY GRATINGS LESS OBJECTIONABLE THAN PRIVATE OPENINGS

Objections presented to the committee to sidewalk gratings rested on the ground either that they constituted obstructions, reducing the width of the street, or that they were objectionable because of the emission of heated air at a disagreeable velocity. The committee found that air was emitted from the subway gratings at an average temperature of 5 to 7 deg. more than that on the street, and that the velocity averaged 1.17 miles per hour for periods when trains were passing below. Sidewalk gratings for ventilating power plants and other purposes, owned by various objecting property owners, were found to emit air at velocities as great as 12 miles per hour and at temperatures ranging from 10 to 112 deg. above the temperature of the outside air. The committee also finds that the gratings of the new subways will be much less objectionable on this score than those of the existing tunnels, and concludes that the designers have kept well within the limits for the emission of heated air hitherto allowed for ventilator gratings.

TRAINS CHANGE AIR RAPIDLY

Investigations were carried on by the committee in the new Fourth Avenue subway in Brooklyn to determine the rate of renewal which might be expected in the subway structures now being built. The Fourth Avenue subway has partitioned walls between the tracks, with small openings near the bottom spaced on 8 to 10 ft. centers. The two outside tracks are used for local service and the center tracks for express service. It was found that when a local train was passing, 92 per cent of the air from the local tunnel went through the wall openings to the express track tunnel, and that of the air in this tunnel 30 per cent passed out through the grating of the express track and 41 per cent passed through the openings of the center wall to the opposite express track. When a local train and an express train passed side by side in the same direction, a total of 27.5 per cent of the air in all four tunnels was forced out through the gratings. When an express train passed with its front platform opposite the rear platform of a local train running in the same direction, 30 per cent of the air in the four tunnels was forced out of the structure. The committee concluded that by reducing the number of openings in the center wall between the express tracks the amount of air forced through the gratings would be increased, as well as the velocity of air drawn in at station entrances. These changes could be made at small expense. It would not do, of course, to close all the partition openings, as ready access from one track to the others is often necessary for passengers or operatives in emergency.

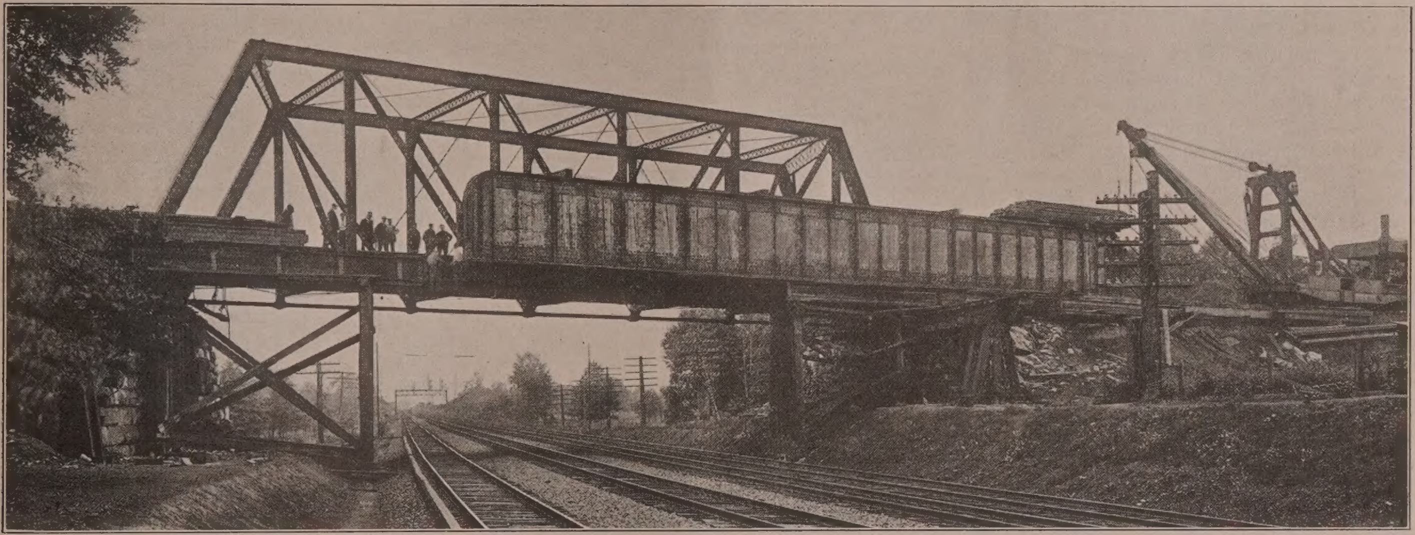
PRESENT PLANS INDORSED

As a result of these investigations, the committee has concluded that the only objectionable condition to be met is found in the high temperature in the subways during the summer months, that no general lowering of this temperature through refrigeration can be obtained at reasonable cost, and that the only practicable method of relief is the one contemplated by the designers of providing as rapid a change of air as possible to dissipate the heat by convection and conduction. In the application of this method it is recommended that the location of sidewalk gratings be carefully studied, and the conclusion is reached that when this is done the gratings will be found less objectionable than any practicable alternative method of ventilation which would secure equal safety and comfort for the public using the subways. In view of the fact that it is concluded that the natural ventilation by train movement, employing large intake and outlet areas and renewing the air at low pressure and velocity, is the only one that can be considered seriously at present, it is further concluded that any objections to the necessary gratings, either as regards their construction or use, should be considered as local problems and not as a condemnation of the general application of this system.

Girder Bridge Replaces Truss Over Fast Express Tracks

Pair of 105-Ton Girders Rolled Across 4-Track Railroad Without Supporting Falsework Between the Tracks

DISPENSING with falsework between the tracks of the four-track railroad below, because of the frequent passing of express trains on the center tracks at 70 miles an hour and more, a pair of 105-ton plate girders for the new 117-ft. double-track bridge of the Pennsylvania Railroad near Langhorne, Pa., were rolled longitudinally from falsework on one side of the road below till they overhung falsework on the other side. The new bridge, which has a concrete floor, replaced an old through-truss bridge on the Trenton cutoff of the Pennsylvania Railroad, crossing over the main line of the Philadelphia & Reading Railway. The two heavy girders, after the longitudinal movement was completed, were spread apart to double-track width, the floor system placed and concreted and the track laid. The old through-truss span, which carried the traffic up to this point, was then slid out and the new one rolled in between trains. The new span, which weighed about 1050 tons, with ballast, had to be lifted from the rollers and supported on I-beams at three corners while the abutments were repaired, and then lowered to its shoes. Instead of the slow and expensive method of driving falsework under the bridge in front of the abutments to carry the jacks, the bridge was raised by lifting angles bolted to the ends of the girders. The number of holes available for these connections was naturally limited, and it was necessary to use Mayari steel bolts, tested to an ultimate strength of 122,000 lb. per square inch, for these hitches. The old bridge trusses were tied together by two cross timbers on top, the floor system and bracing removed, and the outer truss slid, first top and then bottom, a few inches at a time, toward the other truss, which was secured to the new girder on that side, until the two old trusses were side by side and could be removed bodily with derrick cars.



TWO 105-TON GIRDERS, THIRD LARGEST IN THE COUNTRY, BEING LAUNCHED CLEAR OF FALSEWORK ACROSS FOUR-TRACK ROAD BELOW

LITTLE FALSEWORK REQUIRED

A side track south of the main line east of the bridge required eight 4-pile bents for its support. On the caps of these bents 20-in. I-beam stringers were placed, each set of beams being 28 ft. long. These were bolted together through connection angles on their ends, with the joints coming at the caps. On them the girders were unloaded. The rest of the falsework for the lengthwise roll consisted of two timber bents on either side of the Reading tracks, surmounted by eight of the 30-in. girder beams used later for the new bridge floor. These beams on the west side overhung the tracks to pick up the ends of the new girders before they reached the overbalancing point. These beams were counterweighted for their cantilever action by placing beams from the new bridge floor on them. The west bents rested on mud sills and the east bents on piles. Both sets of bents were entirely inside of the falsework for the sidewise movement, part of which was founded on piles and the rest on sills and the steps of the abutment wing walls. This falsework was surmounted by 20-in. I-beams carrying 3-in. plank and two layers of new steel rails, between which roller nests were placed. These I-beams passed behind the girder beams on the first set of falsework, and the east beams were set after the lengthwise roll was made. No other falsework was used for the new bridge. All that described cleared traffic on both roads by safe margins, both in erection and in use.

GIRDERS ROLLED LENGTHWAYS

The girders were unloaded by two locomotive cranes, and set 6 ft. 6 in. apart with the south girder 2 ft. 8 in. ahead of the other to correspond with the skew of the abutments. In this position they were braced together with timber bucks. Pairs of plates, 6 in. wide, bevelled on the ends, and varying in length from 3 ft. 6 in. to 8 ft., were bolted to the bottom flanges of the girders at four points, as shown, with countersunk bolts. These plates were backed up with fillers and punched to go over the rivet heads, the fillers being so arranged that the bottom surfaces of all the plates were in the same plane and lower than any portion of the girders. These plates furnished bearings for the girders on the rollers, which were placed on the longitudinal roller ways.

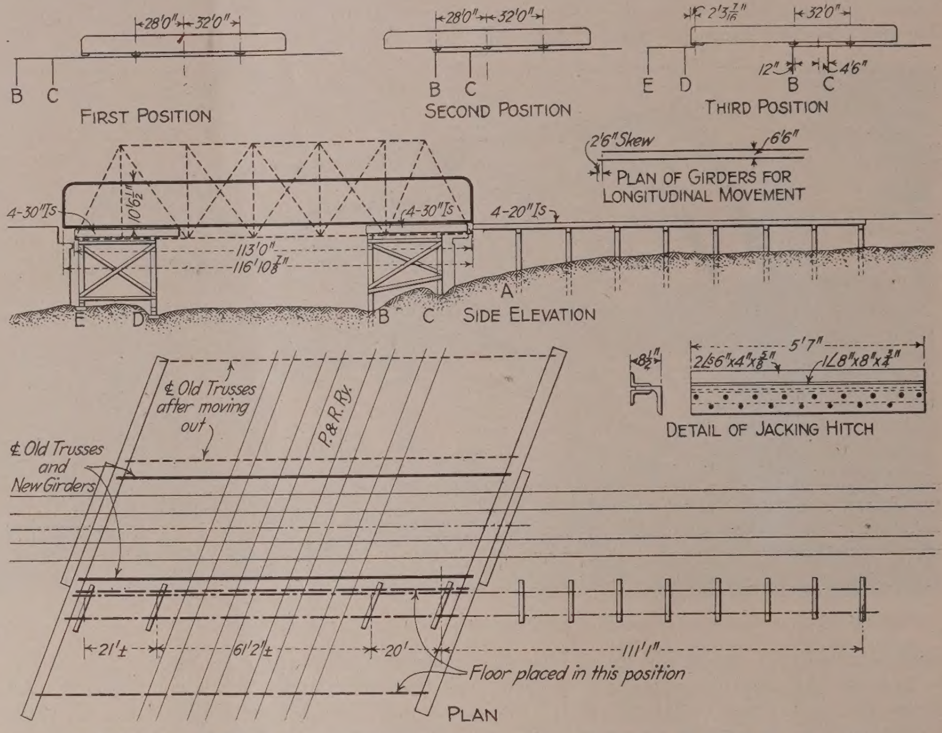
For the first longitudinal movement, rollers were placed under and in advance of the two groups of bearing plates located approximately at the quarter points of the girders, and the movement continued until the advance bearing plates were within 12 in. of the end of the I-beam roller ways, on the east side of the Philadelphia & Reading tracks.

When this position was reached, the rear ends of the girders were jacked up, rollers removed from under the rear bearing plates, and additional rollers were placed under and in advance of a third group of bearing plates located approximately at the center of each of the girders. The rear end of the girders had been counterweighted in advance with I-beams, taken from the floor of the new bridge, so that when the jacks were released the girders took a bearing and pivoted about the new center bearings introduced, thus relieving the load from the forward bearings. The rollers under the forward bearings were then removed, the girders jacked up at the rear end, and rollers replaced under the rear bearings.

The second longitudinal movement then proceeded until the advance ends of the girders overlapped the cantilevered I-beam roller ways on the falsework on the west side of the Philadelphia & Reading tracks. The advance ends of the girders were then jacked up, the rollers under the center bearings removed, and additional rollers inserted under and in advance of the bearings at the advance end of the girders. The jacks were then released, so that in this position the girders were supported on the bearings at the advanced ends and at the rear quarter points. The third movement was then proceeded with until the entire longitudinal movement was completed.

As it was not desirable to stretch tackle across the tracks below, the entire longitudinal movement was made with a set of falls hitched between the west bent of the east falsework and the rear end of the girders, with lead line to derrick car.

For maximum loads, when the girders were resting almost entirely on the center bearing plates, the rollers were spaced on 3½-in. centers, and for minimum loads, when the weight of the girders was approximately equally distributed over two groups of bearing plates, the rollers were spaced on 7-in. centers.



ERECTION FALSEWORK REDUCED TO MINIMUM AND KEPT CLEAR OF BOTH MAIN LINES

Girders Spread and Floor Placed

When the longitudinal movement was completed the south girder was rolled out the proper distance on the falsework provided for the sidewise movement. The floorbeams were then placed and the floor concreted. The bottom forms for the concrete were hung from bolts passing through short wood blocks which rested on the floorbeams. When the tracks on this new span had been laid, the old bridge was jacked up, and thin, lubricated steel sheets were placed between the underside of the shoes and the lower layer of rails on which the old bridge was to slide. As the Trenton cutoff is principally a freight route, and there were no limited trains to take care of, the old and new spans were moved separately. The old one was slid out with two sets of wire rope fails with leads to derrick cars at each side. These falls were then overhauled with runner lines and attached to shackles in the bottom flange of the near girder of the new span. As the new span was 4 ft. longer than the old, these falls passed outside the old end posts with plenty of clearance. The lead lines ran through single blocks shackled to the flange of the north girder. The new span had already been mounted on roller nests, placed between the lower and upper layers of rails, on which the girders rested. The same rollers were used for both longitudinal and sidewise movements. The new span was pulled over to position, jacked up and the rollers and rails removed. The masonry work of the old stone bridge seats was in poor condition, and had previously been replaced at one of the old bridge shoes by a large block of concrete. Three similar bearings had to be constructed for the other shoes, and a new concrete coping placed on one of the abutments. Because of the difficulty of handling the old truss span, whose bottom chords were of eye bars, this work was postponed till the new span was in place. The three shoes for which new concrete bearings were required were omitted temporarily, and the new bridge lowered onto one shoe and three I-beam grillages which spanned the sections to be cut out and replaced with concrete. The cutting was done with air drills and small gasoline-driven compressors. These could be dragged around by one man, and are said to have proved most economical. After the blocks were concreted, the bridge was raised, the grillages removed, the shoes set and the abutment coping removed and replaced with concrete. The jacking hitches, shown in the accompanying sketch, saved the erection of falsework which would have amounted to many times their cost. They were also convenient to use, as they allowed the jacks to be set on solid masonry in accessible positions.

Old Trusses Removed Bodily

The old bridge trusses were each removed by two derrick cars after being brought together as indicated above. They were laid on the side of the embankment at the east end of the bridge and dismantled by driving out the pins and cutting members with a torch.

The girders in this bridge are exceeded in weight and length only by those in the Boston & Albany railroad bridge at Worcester, Mass., and those in the Nickel Plate bridge at Seventy-ninth Street, Chicago, described on page 354 of the Engineering Record for March 11, 1916.

The bridge was designed by H. R. Leonard, engineer of bridges and buildings, Pennsylvania Railroad, and erected under the supervision of George H. Brown, division engineer, by the Seaboard Construction Company of Philadelphia. The erection methods were planned and carried out under the personal direction of S. P. Mitchell, president of the contracting company.

Forest Products Laboratory Identifies Many Samples of Wood

More than 1000 samples of wood are annually submitted to the United States Forest Products Laboratory, Madison, Wis., for identification. The requests vary in importance from one case in which a party wished to know from what kind of wood a particular chess pawn was made to that of a contractor who had thousands of ties rejected by a railroad on the ground that they were red oak instead of white oak as specified.

As a rule, experienced lumbermen can readily distinguish between species commonly handled, but when a particular specimen shows some abnormal growth or discoloration they are in doubt. At the laboratory samples are usually examined under the microscope, which makes visible many characteristics not visible to the unaided eye. The distinguishing characteristics of over 400 native and 100 foreign woods have been studied and arranged in systematic order for use in identifying samples submitted.

Test Results Give Filter Loss-of-Head Data

Various Strainers, Orifices and Sand Were Tested at Oakland, Cal., for Friction Coefficients Much Desired by Filter Designers

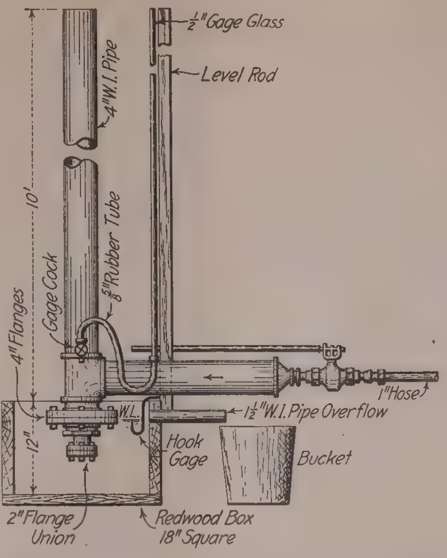
FRICTION coefficients and loss of head through various parts of a filter underdrain system and the behavior of different kinds of sand were investigated by Langdon Pearse in connection with experiments carried out at the testing station of the People's Water Company, Oakland, Cal., in 1908, during the filtration studies at Lake Chabot. The late Arthur L. Adams was in general charge of the work, which was carried out by W. W. DeBerard and Mr. Pearse. The latter presented the information to the American Waterworks Association last spring, but the paper, of which an abstract is here given, has only recently been made available.

The tests of the loss of head in strainers used in rapid filters and in small orifices were made in an apparatus consisting of a redwood box, 18 x 18 in. square and 12 in. deep, inside measurements, a set of 4-in. pipe and flanges arranged as shown, a ¾-in. regulating valve, a level rod fitted with a hook gage, a gage glass, rubber connecting tube and a collecting bucket, holding about 45 lb. of water. Platform scales completed the equipment. The rig was set up in the testing station, the box being supported on wooden legs, while the pail was set on a sink with a drain to the sewer. At first the supply was taken from coagulated water, but the presence of floc, even though a fine screen was used, quickly forced a change to clear water.

ORIFICE PLATES TESTED

The method of operation was as follows: The orifice plate to be tested was set in position between the two flanges of the 2-in. flange union, with a rubber gasket on each side. The valve was then opened and the water allowed to flow through, the joint being carefully inspected for leaks. All the bolts in the flanges were thoroughly tightened before complete submergence. Water was then turned into the box, and when the water had risen above the flange union all the air underneath was sucked out with a small rubber tube. The space underneath was always tested for air after each run at a given head, but little air was found after the first removal. The water was then allowed to rise in the standpipe to the desired head, and when the level in the box had attained a constant elevation the hook gage was set. At first the valve was set, the readings of the head being taken every 10 sec. on the water column. It was found better to maintain a constant level, which was readily accomplished by the aid of the extension handle on the regulation valve. When the apparatus had been running smoothly for a few minutes, usually 2 and not over 5, the bucket was swung under the overflow and allowed to fill for an even number of minutes. It was then removed, weighed on scales and emptied. The weight of a cubic foot of water was taken at 62.4 lb. No correction was made for temperature.

As all the tests were made with the orifices or strainers submerged, the head, h, in feet, given in the tables, is the actual head lost in passing through the orifice or strainer, and is measured by the difference of level of the water inside the standpipe and inside the redwood box.



TESTING DEVICE FOR PLATES AND STRAINERS

In the tables the following abbreviations are used: d = diameter of orifice, t = thickness of plate, C = coefficient of discharge. The orifices in table 1 were holes drilled through steel plates, all burrs being carefully removed. With a very few exceptions the coefficient C varied but little for the range of head tried on any one orifice. On orifices 50 and 49 two independent sets of observations gave results somewhat at variance as noted.

STRAINER PLATE RESULTS

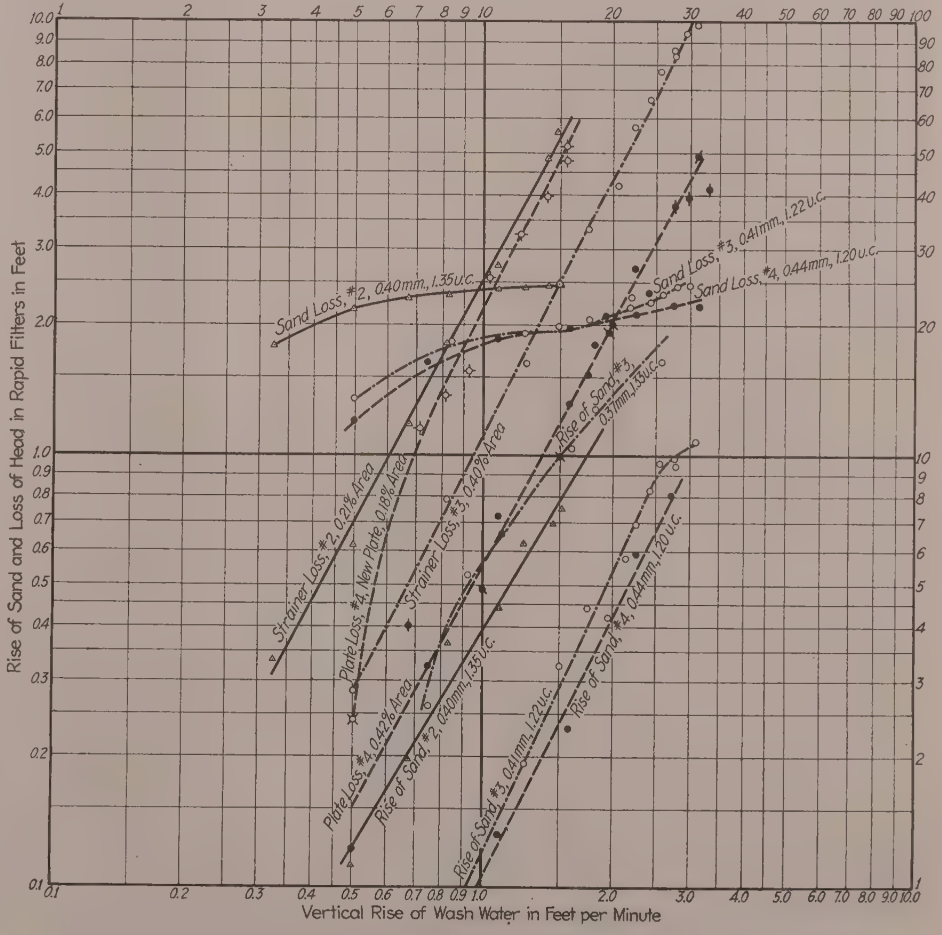
The resulting C is computed on both the supply pipe and the openings for strainers of the Wilson, Greer and Little Falls type.

For the Wilson type, as used at Binghamton, N. Y., the average of three heads, 2.173, 3.96 and 7.18 ft., gave C values of 0.329 based on the slots and 0.42 based on the pipe area. The pipe area is 0.864 sq. in. and the slot area 1.101 sq. in.

TABLE 1—TESTS OF ORIFICES

	Nominal Dimensions		Actual Dimensions					
Orifice Number	d In.	t In.	d In.	t In.	Ratio $\frac{d}{t}$	Aveage Value C	Range of Head Ft.	No. of Tests Averaged
54	¼	1/16	0.2486	0.0601	4.138	0.624	1.25- 9.91	13
53	3/16	1/16	0.189	0.0601	3.15	0.612	2.0 -10.0	13
52	5/32	1/16	0.1569	0.0601	2.61	0.622	1.20-10.0	11
51	⅛	1/16	0.1266	0.0601	2.11	0.635	1.99-10.0	10
50	3/32	1/16	0.093	0.0601	1.547	0.68†	1.20-10.0	10
49	1/16	1/16	0.0619	0.0601	1.03	0.741*	1.99-10.0	9
48	¼	5/64	0.25	0.0801	3.01	0.612	1.92- 9.8	11
47	3/16	5/64	0.1904	0.0801	2.38	0.612	1.99- 9.92	5
46	5/32	5/64	0.1572	0.0801	1.96	0.678	2.0 -10.0	5
45	⅛	5/64	0.1272	0.0801	1.59	0.718	2.0 -10.0	5
44	3/32	5/64	0.0935	0.0801	1.17	0.739	2.0 -10.0	5
43	1/16	5/64	0.0609	0.0801	0.761	0.852	2.0 -10.0	5

*Averaged from 2 sets, $C = 0.689$ and $C = 0.794$.
†Averaged from 2 sets, $C = 0.780$ and $C = 0.640$.



SAND RISE AND LOSS OF HEAD ARE PROPORTIONAL TO VERTICAL RISE OF WASH WATER

The Denver strainer, tested at three heads, 1.049, 1.326 and 1.555 ft., gave a *C* value of 0.731.

In the Greer strainer the throat and slot areas are 0.132 and 0.4844 sq. in. respectively. The *C* coefficients were found to be 0.7077 for the throat and 0.1929 for the slots on heads varying from 1.074 to 7.654 ft. in fifteen different runs.

The Little Falls strainer has an inlet pipe of 0.1135 sq. in. area, while the holes have an area of 0.1161 sq. in. *C* varied from 0.48 to 0.49 on the inlet area and from 0.469 to 0.479 based on the hole area. There were three runs at each of the six different heads, the latter varying from 1.07 to 3.14 ft.

In the Columbus (Ohio) strainer plate the average coefficient *C* for twenty-eight observations was 0.736 for heads varying from 1 to 10 ft.

COMBINED SAND AND STRAINER TESTS MADE IN FILTERS

Tests of loss of head in the strainers and sand were made in the working experimental filters, each 4 ft. square inside dimensions. In filter 2, the underdrain was of the combined type designed to use air and water alternately through a single pipe system similar to the one installed at Harrisburg, Pa. This underdrain consisted of a 3-in. galvanized-iron pipe header with eight lateral pipes, 1¼-in. diameter, spaced on 6-in. centers. On the underside of the pipes were drilled 7/32-in. diameter holes spaced on 3-in. centers, making a total of 128 holes, with a total area of 4.81 sq. in., equivalent to 0.21 per cent of the area of the filter.

Filter 3 was designed for a high-rate wash, with water only, using a pipe system similar to the first, but with a 4-in. header and 2-in. laterals. On the underside of the pipes there were drilled eight rows of fifteen holes each, of approximately 5/16 in. diameter. The total area of the holes was 9.204 sq. in., equivalent to 0.40 per cent of the area of the filter. A wire screen was placed over the gravel and tied down to prevent displacement by the high velocity of the wash water.

Filter 4 had an underdrain modeled after that at Cincinnati, Ohio, except that it was built of wood instead of concrete, and the wire screens over the gravel were omitted. There were six plates, each containing fifty-eight holes 3/16 in. in diameter. The total area of the 348 holes in the plates was 9.6 sq. in., equivalent to 0.42 per cent of the area of the filter. During the experiments the filter was rebuilt, using plates each containing the same number of holes as before, but ⅛ in. in diameter, equivalent to 0.18 per cent of the area of the filter.

The curves shown are on a logarithmic scale. In each case for filters 2, 3 and 4 a curve is drawn showing the strainer or plate loss and the sand loss for various rates of wash water. In addition, the rise of the sand is given. In general the finer sand with a higher uniformity coefficient rose to a greater height with a given vertical rise of wash water.

METERED SERVICES IN KANSAS CITY numbered 71 per cent of the total, according to the report for the year ending April 19, 1915, by D. L. Wheelock, superintendent of the meter division of the water department. There are at present 35,601 meters of various makes in service, of which 5059 were set during the last fiscal year.

Reproduction Cost Allocated Between Freight and Passenger Service

Engineer of Missouri Public Service Commission Uses Ton-Mile Basis Mainly in Report on Mississippi River & Bonne Terre Railway

ALLOCATION of reproduction cost between freight and passenger service is included in the appraisal report, recently completed, of W. W. K. Sparrow, assistant chief engineer of the Missouri Public Service Commission, on the Mississippi River & Bonne Terre Railway. This railway, a small one in the southeastern part of the state, had opposed the two-cent fare law ever since its passage some eight years ago. Although the state won when the case was fought through to the U. S. Supreme Court, the court holding that the evidence did not show the rate to be confiscatory, the railway applied for relief to the State Public Service Commission when it was created a short time afterward, asking for an increase in passenger rates only. And the commission ruled that before it could pass upon the question a valuation must be made, showing the cost of reproduction new and the cost of reproduction new less depreciation, with the property in use of freight service and passenger service shown separately.

As W. J. Wilgus did in his allocation of maintenance expenses in the Ulster & Delaware case (see the Engineering Record of Aug. 21, 1915, page 226), Mr. Sparrow has made the ton-mile the fundamental basis of his division of the accounts. His problem was complicated by the fact that some of the lines of the railway carry no passenger traffic, and that certain facilities used by the whole system had to be allocated to the different lines according to their traffic, as well as to the classes of traffic of the whole system. The appraisal itself is notably different from that of some other state commissions in that, for example, contingencies, appreciation of roadbed and land values in excess of present normal market value are allowed, the latter being determined by an unusual process set forth in the report. The following abstract of the report is intended to embrace only such phases and items of the appraisal as have been handled in an unusual way.

THE RAILROAD

The first line of the Mississippi River & Bonne Terre Railway was built about 1880, and extensions and branch lines were constructed from time to time until a main-track mileage of 64 miles was reached. Some of the lines are used exclusively for freight. The road is built through a heavy rolling country. On the main line the ruling grade is 1.8 per cent and the maximum curvature 12 deg. Of the branch lines the ruling grade is 3 per cent and the maximum curvature 18 deg. The road has its main outlet at Riverside, the northern terminus, where it connects with the St. Louis, Iron Mountain & Southern Railway.

BASIS OF REPRODUCTION, CONDITIONS AS ON DATE OF VALUATION

In making the appraisal in connection with the rate controversy, we have assumed:

(a) That the road is to be reproduced as it existed at the date of valuation, of new material, at proper prices existent at that date.

(b) That the physical and topographical conditions of the country through which it passes and the condition as to population, business capacity and property values in the territory served by it are as existing at the date of valuation.

(c) That all transportation facilities existing at the date of valuation, with the exception of the property under course of reproduction, are in existence.

(d) That as the construction of the property being reproduced proceeds it shall be available for transportation purposes.

(e) That the records, plans and other historical data in possession of the company at the date of valuation are available for use and reference as a means of arriving at correct estimates.

The method of ascertaining cost of reproduction new under the assumed conditions as stated was not applied in the determination of the value of the land.

UTILIZATION OF FEDERAL INVENTORY

To avoid the unnecessary duplication of work and expense the state commission sought and obtained the co-operation of the Division of Valuation of the Interstate Commerce Commission, which had begun work in the state. The division proceeded with the inventory on this property and allowed the state commission engineers to accompany the field parties and make copies of such information as they desired. The road and track party completed its work in February, 1915, and later in the year a bridge and building party and a mechanical party covered the system. The right-of-way was inventoried by the state commission's engineers, no inventory of the property being made by the Division of Valuation at this time.

For the purpose of making a division of the property between freight and passenger service, the commission's engineers made a careful and independent study of the property, classifying it under three heads, according as it was used exclusively for freight, passenger or joint service.

Clearing and grubbing has been estimated on the basis of the amount of such work that would have to be performed were the line being constructed at this time.

SHRINKAGE OF EMBANKMENT

No addition was made to the embankment quantities as computed from the actual measurements made in the field. It is recognized that earth in a well compacted embankment will occupy less volume than in its original position, but as offsetting this the solid rock when broken up will occupy a relatively greater volume.

As a rough average approximation, clayey earth is usually estimated to shrink 10 per cent and solid rock to swell from 40 to 50 per cent. The classification of roadbed material for this line was as follows: Earth, 43 per cent; chat from the neighboring mines and loose rock, 44 per cent; solid rock, 13 per cent. If the earth is assumed to shrink 10 per cent, the solid rock to swell 45 per cent and the loose rock and chat occupy approximately the same volume, the swell in the rock will more than offset the shrinkage in the earth. Probably a part of the voids of the rock is filled by the earth, but how much is impossible of even an approximation without knowledge of the manner in which the materials were deposited.

For these reasons it has been considered quite impossible to make any approximation of the additional quantities, if there be any, as should be added on account of shrinkage, and it was therefore decided to consider this feature in connection with appreciation of roadbed, and make a blanket allowance to cover both.

APPRECIATION ALLOWED

Those opposing any allowance for appreciation claim either that it costs nothing or that if it did cost anything it was paid for out of operating expenses and therefore it would be improper to capitalize it. In reply to the first argument the writer believes that in common equity, if you are going to decapitalize on account of the action of the elements in causing physical depreciation, you certainly ought to capitalize any added value brought about by the same forces; and in reply to the second argument, the writer is of the opinion that the additional cost during the first few years of operation is incorrectly termed maintenance, and is in reality a deferred construction cost.

Our principal problem is to report all elements of value, and the seasoned and solidified roadbed has without argument an element of value not found in entirely new construction. We have no means of determining the amount of solidification or settlement, or its value, but an estimate has been made based on the increased cost of maintenance for the first five years, and an addition of 10 per cent has been made to all embankment quantities to cover both shrinkage and solidification of roadbed. This is believed to be conservative.

UNUSUAL TREATMENT OF LAND

As already stated, the value of the land has not been determined by the method of cost of reproduction new. The "fair present value," as shown in this appraisal, has been arrived at in conformity with the principles laid down in the opinion of this commission in the Missouri Southern case. In that opinion Commissioner Kennish, discussing this question, says:

"In our opinion, it was not intended to be held in the case quoted from (Minnesota Rate Cases, 230 U. S., 352) that if the company necessarily incurred cost in acquiring its right-of-way in excess of the market value of the land, that such be established by competent evidence, the court would still be limited in determining right-of-way value, to the market value of contiguous lands. For the necessary investment of a common carrier in acquiring a right-of-way is clearly a property right, and as such is entitled to protection by constitutional guarantee. . . .

"In our opinion, in determining the fair present value of the right-of-way, the company is entitled to the same value per acre as the present market value of contiguous lands, plus the added cost of acquisition as shown by the evidence."

The sum and substance of this decision is that in such cases as the company in acquiring its land necessarily incurred costs in excess of the market value of the land at that time, the fair present value shall be such original cost plus the increment in the value of the land since its acquisition up to the present date, the cost of acquisition to the company being the difference between the market value of the land at the date of acquisition and the cost to the company. Where the land was donated, or where the original cost did not exceed or was less than the market value at the date of acquisition, the fair present value is the present market value of similar and contiguous lands.

LAND DATA REQUIRED

It was therefore necessary in order to arrive at the fair present value to determine (a) the original cost to the company, (b) the market value of the land at the date of acquisition, and (c) the market value of contiguous and similar land as of the date of valuation.

In obtaining the original cost the railway company's deeds, records and all documents relating to this subject were carefully examined. Every deed was also checked up with the right-of-way maps of the company. The records of both county courts were also examined in checking up such information as was deemed necessary. In obtaining the original market value of the land recourse was had to inhabitants who resided in the neighborhood before the railway was built, and also to others well informed as to conditions and values of land at that time. In obtaining the present market value of land a most thorough and detailed investigation was made. Beginning at Riverside, the entire right-of-way of both main and branch lines was personally examined. Inquiries were made as to sales of land in the vicinity of the right-of-way within recent years, and a considerable number of such sales were run down, and the amount of the transaction ascertained. Also what were considered to be the best informed authorities were interviewed and their opinions obtained as to the market value of land in the vicinity of the right-of-way.

The unit prices were arrived at after making a careful examination of the records of this and other railway companies in this part of the state. Contracts and records of actual cost were investigated as an aid in determining the proper prices for work of similar character at the date of valuation. Material prices were arrived at after studying the prevailing prices and price tendencies during a reasonable period preceding the date of valuation. Contractor's profit, freight, inspection and other charges usually attendant to railroad construction were included in the unit prices adopted.

ENGINEERING ESTIMATED IN DETAIL

A program covering the period of construction was made out and a detailed estimate made of the cost of the engineering, embracing all the necessary work involved under the following divisions: (1) Reconnaissance, (2) preliminary surveys, (3) final location, (4) special designing of bridges and buildings, (5) construction, (6) equipment, (7) preparation of records, maps and plans.

Legal expenses were assumed to be 1 per cent on all road accounts exclusive of land. Organization, taxes, stationery and printing were assumed to be 1½ per cent on all road and equipment accounts exclusive of land. Interest during construction was allowed at the rate of 3 per cent on the total cost to reproduce new for the full estimated period of construction. No allowance was made for discounts on bonds.

Contingencies may be divided into two classes—contingencies of commission in inventory, and contingencies of construction. As regards the former, we believe that in view of the care and thoroughness with which this inventory was prepared and the very complete records of the company the error in this respect is small. As to contingencies of construction, while it is true that the knowledge gained from the study of the records and construction of the road in the past ought to be of considerable assistance in arriving at an accurate estimate, and without doubt eliminates some items of contingency, yet we believe that it would be unreasonable to assume that such knowledge would enable any one to foretell and provide for all the uncertain and indeterminate expenses entirely dependent upon circumstances and conditions which might arise were the line being reproduced to-day. No better illustration of this can be given than the present war in Europe. Had the contract for this road been let, say, a year previous to the assumed date of valuation, which was June 30, 1915, on prices prevalent at that time, the work could not have been completed on the estimate.

The value of the stores and supplies on hand as shown by the books of the company for June 30, 1914, together with what was considered a reasonable amount of working cash, was allowed under the head of working capital and stores and supplies on hand.

DEPRECIATION

At the conference held in Washington May 27-29, 1915, by the Division of Valuation, Interstate Commerce Commission, the answer of the state commissions to the question, "How shall depreciation be determined?" was as follows:

"Deferred maintenance, if any, should first be determined. Age to date of appraisal and scrap value shall be ascertained and stated. Expected life shall be determined after inspection, examination of records and consideration of all factors that affect the period of usefulness. The accrued depreciation shall then be ascertained by ratio which age bears to total life applied to cost less scrap value. Deferred maintenance, if any, shall be added to this amount."

The general principles as covered by the foregoing answer have governed the State commission's engineers in arriving at the depreciation as reported. In the case of shop machinery and equipment the service conditions determined by the engineers of the Interstate Commerce Commission and the master mechanic of the railway were adopted.

ALLOCATION ACCORDING TO USE

The decisions of the United States Supreme Court clearly established the principle that the reasonableness of passenger or freight rates shall be determined upon the fair value of the property used in each service. This appraisal, therefore, to be of any value to the commission in passing upon the merits of the railway company's application for an increase in passenger rates, must show the cost of reproduction new and cost of reproduction new less depreciation not only for the whole properties, but also for the property used in freight service and for that used in passenger service.

With this end in view the commission's engineers made a careful and detailed study of the properties in conjunction with C. H.

Fake, chief engineer of the railway, and have separated all property used exclusively in freight service, used exclusively in passenger service or used jointly.

In the Minnesota rate decision the United States Supreme Court said: "When rates are in controversy it would seem to be necessary to find a basis for a division of the total value of the property independently of revenue, and this must be found in the use that is made of the property; that is, there should be assigned to each business that proportion of the total value of the property which will correspond to the extent of its employment in that business."

Relative to the term "use," it may be considered that the use made of the track is best measured by the occupancy, or, on the other hand, that the amount of wear and tear of the track is the best gage. There also enters the question of the weather stress, which cannot be divided on any basis of use. It is estimated that from 25 to 50 per cent of the expense of maintaining a track is due to the action of the elements.

LOCOMOTIVE TON-MILE OR GROSS TON-MILE

There are also the divergent views of those favoring the locomotive ton-mile as against those who think the gross ton-mile is the proper basis for dividing those accounts and are directly affected by the weight of the traffic. Those who champion the locomotive ton-mile contend that the gross ton-mile basis does not take into consideration nor compensate for the greater speed of passenger trains over freight trains. They hold that the high-speed passenger train does more damage to the track and structures and consequently increases the cost of maintenance. Those favoring the gross ton-mile method contend that the greater speed of the passenger trains is more than offset by the destructive action of freight trains, such as drippings from refrigerator cars, which are detrimental to the floorbeams and stringers of steel bridges and to track fastenings, rails and switches; the more imperfect equipment with much higher wheel concentration, the stiffer, more rigid and less delicately adjusted springs of freight cars, which cause greater shock to the track and structures.

The writer believes that in the absence of any exact scientific basis for determining the relative amount of injury done to the track by freight and passenger service and also in view of the many unknown and indeterminate factors, such as the damage caused by elemental action, the gross ton-mile method is the more reasonable and equitable in arriving at what in the final analysis cannot be regarded as anything but an approximation. No attempt has been made to take weather stress into consideration, as it seems foolish to undertake refinements at this one point.

APPORTIONMENT BASED ON ONE MONTH'S TEST

The apportionment between freight and passenger service of that property in joint use of both classes of service is based upon figures obtained during a test extending over the month of September, 1914. The basis of the apportionment, together with the percentages for each account, are as shown in the accompanying tables. The property in exclusive passenger or exclusive freight use is, of course, allocated direct.

The apportionment of all equipment between freight and passenger service has, with the exception of work equipment, been made in accordance with the class and character of the equipment.

The locomotives have been apportioned between main and branch lines on the basis of the locomotive ton-mile rather than the locomotive mile, for the reason that the weight of the engine directly reflects its value, and consequently this method gives the more accurate and scientific results. For example, it is quite possible for the lighter locomotives to be used on the branch lines and make the same mileage as the heavier ones on the main line. In such a case a division of values on the basis of locomotive miles would give incorrect results.

The work equipment has been apportioned between freight and passenger service on the basis of locomotive ton-miles, as it is believed that the relative volume of traffic thus reflects the use made of this class of equipment. The percentage to freight service is 80 per cent, and to passenger service 20 per cent. The results thus obtained are then apportioned between

TABLE I—BASIS OF APPORTIONMENT OF MAIN-LINE ROAD ITEMS, AND FREIGHT AND PASSENGER PERCENTAGES

Account	Basis of apportionment	Per cent of total Freight	Per cent of total Passenger
Engineering	Average of value of allocations, accounts 3 to 46 inclusive	77.5	22.5
Grading; bridges, trestles and culverts; ties; rails; other track material; ballast; track laying and surfacing; roadway buildings; roadway machines; roadway small tools	Locomotive ton-miles	76.5	23.5
Land for transportation purposes; tunnels and subways, right-of-way fences; crossings and signs: signals and interlockers	Revenue train-miles	45	55
Station and office buildings	Detailed estimate made separating such space in exclusive use of freight or passenger service. Space in joint service apportioned on basis of revenue train-mile.	...	...
Water stations	Cost of water supplied to each class of service	78	22
Fuel stations	Cost of fuel supplied to each class of service. Only fuel station is at Bonne Terre and is common to whole system. Apportionment between freight and passenger is made for whole system and then further apportioned between main and branch lines on locomotive-mile basis.	78	22
Shops and engine houses			
Engine house and miscellaneous buildings, Herculaneum	Cost of service rendered	66	34
Buildings under this account located at Bonne Terre	Apportionment between freight and passenger made for whole system as shown below, and then further apportioned between main and branch lines according to the percentages in Table 2	..	...
Machine and boiler shop	Cost of locomotive repairs	80	20
Engine house	Cost of service rendered	90	10
Flue rack and flue-cleaning sheds; oil houses; sand drying house; sand trestle; cinder pit	Locomotive-miles	70	30
Woodworking shop	Cost of repairs to freight and passenger cars	90	10
Blacksmith's shop; coal house; master mechanic's office and vault	Cost of repairs to all equipment	88	12
Paint shop	Used exclusively in passenger service	....	100
Store house; yard toilet house; hose house; scrap platform; sewerage and drainage; water-supply system	Average of value of above allocations	73.5	26.5
Power-plant buildings	Apportioned on basis of power supplied and amounts allocated to freight and passenger service of shops to which power is supplied		
Boiler and pump room		80	20
Transformer house		88	12
Power distribution system	Same basis as power-plant buildings	88	12
Shop machinery			
Property under this account located at Riverside, Herculaneum, Flat River, Rivermines and Elvins	Cost of locomotive repairs	80	20
Property under this account located at Bonne Terre in common to whole system.	Apportionment between freight and passenger made for whole system as shown below, and then further apportioned between main and branch lines as per Table 2	.	...
Engine house	Cost of service performed	90	10
Machine shop; boiler shop	Cost of locomotive repairs	80	20
Flue cleaning shed	Locomotive miles	76.5	23.5
Woodworking shop	Cost of repairs to freight and passenger cars	90	10
Blacksmith's shop; master mechanic's office	Cost of repairs to all equipment	88	12
Paint shop	Used exclusively for passenger	....	100
Miscellaneous tools and equipment in Bonne Terre yards	Average of values of above allocations	82.5	17.5
Power-plant machinery	Apportioned on basis of power supplied and amounts allocated to freight and passenger service of shops to which power is supplied	80	20
Power substation apparatus	Same basis as power-plant machinery	88	12

TABLE 2—APPORTIONMENT IN PERCENTAGES OF BONNE TERRE SHOPS AND ENGINE HOUSE BETWEEN MAIN AND BRANCH LINES

Item	Basis of division	Main Line Freight	Main Line Passenger	Hoffman Branch Freight	Hoffman Branch Passenger	Crawley Freight	Crawley Passenger	Gumbó and Mitchell Freight	Gumbó and Mitchell Passenger
Machine shop and boiler shop, engine house, flue rack shed, flue cleaning shed, oil houses, sand-drying house, sand trestle, cinder pit	Locomotive miles	74.2	90.5	14.7	9.5	2.2	0	8.9	0
Woodworking shop	Car mileage, freight and passenger	83.5	91.0	8.3	9.0	1.8	0	6.4	0
Blacksmith shop, coal house, master mechanic's office and vault	Locomotive freight and passenger car mileage	82.3	91.0	9.2	9.0	1.8	0	6.7	0
Paint shop	Passenger car miles	....	91.0	....	9.0	....	0	....	0
Store house, yard toilet house, hose house, scrap platform, sewerage and drainage, water-supply system	Average of above allocations	80.0	90.9	10.7	9.1	1.9	0	7.4	0

TABLE 3—DERIVATION FROM PERCENTAGES OF TABLES 1 AND 2 OF CERTAIN MAIN-LINE ITEMS OF BONNE TERRE SHOPS

Item	Allocation of whole traffic, per cent Freight 1	Allocation of whole traffic, per cent Passenger 2	Allocation to main line, per cent Freight 3	Allocation to main line, per cent Passenger 4	Reproduction cost for whole system Total 5	Reproduction cost for whole system Freight 6	Reproduction cost for whole system Passenger 7	Reproduction cost for main line Freight 8	Reproduction cost for main line Passenger 9	Reproduction cost for main line Total 10
Machine and boiler shop..	80.0	20.0	74.2	90.5	$14,534	$11,627	$2,907	$8,627	$2,631	$11,258
Engine house...........	90.0	10.0	74.2	90.5	8,243	7,419	824	5,505	746	6,251
Blacksmith shop, etc.....	88.0	12.0	82.3	91.0	7,995	7,036	959	5,791	873	6,664
Paint shop.............	0.0	100.0	0.0	91.0	7,107	0	7,107	0	6,467	6,467

main and branch lines on the relative percentages that the locomotive ton-miles for each class of service for each system are at the total.

EXPLANATION OF TABLES

[Space permits the presentation of only few of the tables. Table 1 gives the basis of apportionment and the freight and passenger percentages for various of the road accounts for the main line. Table 2 shows the basis of apportionment between main and branch lines of the general shops and engine house.

Table 3 is compiled from several of Mr. Sparrow's tables in an attempt to show the application of the various percentages. The percentages in columns 1 and 2 are taken from Table 1, and those in columns 3 and 4 from Table 2. Starting with the total reproduction cost of the item, column 5, this figure multiplied by the percentage gives the amount chargeable to the freight service of the whole system, column 6. This in turn, multiplied by the percentage in column 3, gives the amount chargeable to the freight traffic of the main line, column 8. Likewise the application of the percentage factors of columns 2 and 4 to the total in column 5 gives the amounts in columns 7 and 9. The matter is set forth more fully in the various appendices of the report, but space limitations preclude their presentation here. The same process is gone through with reproduction cost less depreciation the base.

Table 4 gives the itemized cost figures for the main line and Table 5 summarizes them. The main-line figures are given rather than those for the whole system, for the reason that the percentages give a better criterion for other roads than if lines used exclusively for freight purposes were included.—EDITOR.]

TABLE 4—ITEMIZED APPRAISAL FIGURES FOR MAIN LINE

		Cost of reproduction new			Cost reproduction new less depreciation		
		Freight	Passenger	Total	Freight	Passenger	Total
		I—Road					
1.	Engineering	$52,867	$15,348	$68,215	$47,907	$13,909	$61,816
2.	Land for transportation purposes			(See below)			
3.	Grading	676,659	171,177	847,836	732,556	184,705	*917,261
5.	Tunnels and subways	4,840	5,915	10,755	4,840	5,915	10,755
6.	Bridges, trestles and culverts	196,423	57,065	253,488	165,299	47,966	213,265
8.	Ties	103,978	22,308	126,286	51,989	11,154	63,143
9.	Rails	204,243	46,367	250,610	169,088	39,297	208,385
10.	Other track material	53,210	9,050	62,260	41,181	7,109	48,290
11.	Ballast	51,952	11,373	63,325	44,160	9,666	53,826
12.	Tracklaying and surfacing	73,977	15,562	89,539	66,578	14,006	80,584
13.	Right-of-way fences	15,119	17,562	32,681	9,135	10,643	19,778
15.	Crossings and signs	7,120	7,732	14,852	6,122	6,809	12,931
16.	Station and office buildings	33,792	39,872	73,664	26,512	30,822	57,334
17.	Roadway buildings	5,675	1,744	7,419	3,995	1,227	5,222
18.	Water stations	9,170	2,587	11,757	7,825	2,207	10,032
19.	Fuel stations	2,753	947	3,700	1,926	662	2,588
20.	Shops and engine houses	43,362	18,829	62,191	31,781	14,969	46,750
27.	Signals and interlockers	1,405	1,719	3,124	1,140	1,393	2,533
29.	Power-plant buildings	1,218	304	1,522	978	245	1,223
32.	Power-distribution system	490	67	557	360	49	409
37.	Roadway machines	1,857	571	2,428	1,300	400	1,700
38.	Roadway small tools	548	169	717	384	118	502
44.	Shop machinery	49,441	12,376	61,817	36,112	8,804	44,916
45.	Power-plant machinery	1,095	274	1,369	684	171	855
46.	Power substation apparatus	431	59	490	345	47	392
		$1,591,625	$458,977	$2,050,602	$1,452,197	$412,293	$1,864,490
	Contingencies, 5 per cent on above	79,581	22,949	102,530	72,609	20,614	93,223
	Estimated "fair present value" of land for transportation purposes	101,513	118,860	220,373	101,513	118,860	220,373
		$1,772,719	$600,786	$2,373,505	$1,626,319	$551,767	$2,178,086
		II—Equipment					
51.	Steam locomotives	$196,838	$35,949	$332,787	$131,446	$19,465	$150,911
53.	Freight-train cars	856,427	....	856,427	624,423	....	624,423
54.	Passenger-train cars	....	60,591	60,591	....	39,175	39,175
57.	Work equipment	27,344	8,386	35,730	19,471	5,971	25,442
		$1,080,609	$104,926	$1,185,535	$775,340	$64,611	$839,951
		III—General					
73.	Legal expenses	$16,712	$4,819	$21,531	$15,248	$4,329	$19,577
71.	Organization						
74.	Stationery and printing	41,277	8,803	50,080	34,502	7,463	41,965
75.	Taxes						
76.	Interest during construction	131,009	32,370	163,379	110,313	28,267	138,580
	Working capital, stores and supplies	65,600	16,400	82,000	65,600	16,400	82,000
	Grand total	$3,107,926	$768,104	$3,876,030	$2,627,322	$672,837	$3,300,159

*This item appreciated, and the amount of appreciation has been added to "Cost of Reproduction New."

TABLE 5—SUMMARIZED ALLOCATION OF REPRODUCTION COST TO FREIGHT AND PASSENGER SERVICE, MAIN LINE

	Freight		Passenger		
	Amount	Per cent	Amount	Per cent	Total
	I—Road; Cost of Reproduction New				
In joint service	$1,436,025	71.7	$565,435	28.3	$2,001,460
Exclusively freight	336,694	100.0	....	....	336,694
Exclusively passenger	....	....	35,351	100.0	35,351
	$1,772,719	74.7	$600,786	25.3	$2,373,505
	Cost of Reproduction New Less Depreciation				
In joint service	$1,326,769	71.6	$524,767	28.4	$1,851,536
Exclusively freight	299,550	100.0	......	....	299,550
Exclusively passenger	....	....	27,000	100.0	27,000
	$1,626,319	74.7	$551,767	25.3	$2,178,086
	II—Equipment; Cost of Reproduction New				
In joint service	$27,344	76.5	$8,386	23.5	$35,730
Exclusively freight	1,053,265	100.0	....	....	1,053,265
Exclusively passenger	....	....	96,540	100.0	96,540
	$1,080,609	91.2	$104,926	8.8	$1,185,535
	Cost of Reproduction New Less Depreciation				
n joint service	$19,471	76.5	$5,971	23.5	$25,442
Exclusively freight	755,869	100.0	....	....	755,869
Exclusively passenger	....	....	58,640	100.0	58,640
	$775,340	92.3	$64,611	7.7	$839,951
	Road, Equipment, General; Cost of Reproduction New				
In joint service	$1,599,006	71.9	$624,823	28.1	$2,223,829
Exclusively freight	1,508,920	100.0	....	....	1,508,920
Exclusively passenger	....	....	143,281	100.0	143,281
	$3,107,926	80.0	$768,104	20.0	$3,876,030
	Cost of Reproduction New Less Depreciation				
In joint service	$1,464,527	71.7	$577,199	28.3	$2,041,726
Exclusively freight	1,162,795	100.0	....	....	1,162,795
Exclusively passenger	....	....	95,638	100.0	95,638
	$2,627,322	79.6	$672,837	20.4	$3,300,159

Arch Centering of Reinforced Concrete Suspended

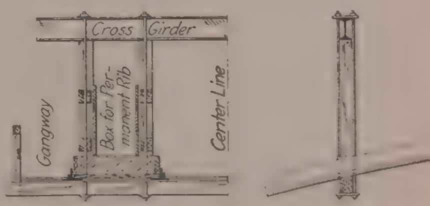
Economy and Safety Result from Unique Design for Suspended Centering Used in Erecting Reinforced-Concrete Arches

THE REPLACEMENT of an existing steel truss highway bridge by a reinforced-concrete arch structure over a torrential river subject to frequent high floods, presented a difficult erection problem because the arch centering could not be supported from below. Although the existing bridge could be utilized to suspend the centering, it was found that ordinary timber forms would be too weak when suspended from the available points on the truss bridge. As described and illustrated in the London *Engineer*, the designers, therefore, decided to use reinforced-concrete centering composed of light, flexible ribs on which the main rib could be cast. The following abstract of the article in the *Engineer* explains how the centering was designed.

THEORY OF ADOPTED DESIGN

The plan adopted was to erect by suspension a pair of light reinforced-concrete ribs, each of which would be sufficient to bear the load of a single permanent rib if prevented from deflecting, and to rely on the existing trusses above to furnish the necessary stiffening. These trusses, according to this plan, fulfill exactly the function of the trusses of a stiffened suspension bridge, the flexible reinforced-concrete ribs being merely the catenary of the cables inverted. From each panel point of the truss bridge the temporary rib is both suspended by a pair of tie rods and strutted by a post, so that it was firmly fixed at all such points.

The temporary rib was made 3 ft. 6 in. wide and 10 in. deep. It was suspended from transverse girders placed below the old floor system immediately adjacent to the panel points. The suspension rods were pairs of bolts hung from stirrups over the top of the beams, and the struts were timber posts between the rods fitted in between the top of the rib and the bottom of the



DETAILS OF SUSPENDED CENTERING

cross beam. The arrangement is shown in the accompanying diagram.

DETAILS OF CENTERING

The posts were bedded on seats formed on the curved concrete centering. They were spaced far enough apart to allow room for the boxing in which to mold the permanent ribs. The suspension rods passed through and supported timber crossties, which were common supports to both temporary ribs, and the whole was tightened up by the nuts at the ends of the rods. The temporary ribs were molded in shallow troughs, which were carried each by two 6 x 6-in. angles curved to the form of the arch and extending from skewback to skewback.

The temporary ribs were cast in two days. They had nearly two months to set before boxing and reinforcement were ready and all preparations made for casting the permanent ribs. To guard against adhesion they were finished very smooth and well oiled. The permanent ribs were given a month to set before the superstructure was proceeded with.

The temporary ribs were removed by being cut away at the crown. This was not a difficult operation, as they projected outside the main ribs; two masons chipped away at the concrete until the section was so reduced that the rib failed by crushing and fell away into the river.

The saving over the usual method of substantial self-supporting centering was very considerable, to say nothing of the total absence of flood risk and consequent anxiety.

DEATHS FROM TYPHOID in Pennsylvania have been greatly reduced since the State Department of Health was organized ten years ago. The rate per 100,000 was 54.8 in 1906 as against 13.0 in 1916. Estimates place the number of lives saved at 18,869.

GIRDER SPANS HAVE ARCH OUTLINES—NOTE EXPANSION JOINT AT PIER

Corpus Christi Causeway Contains 2300 Feet of Reinforced-Concrete Girder Spans

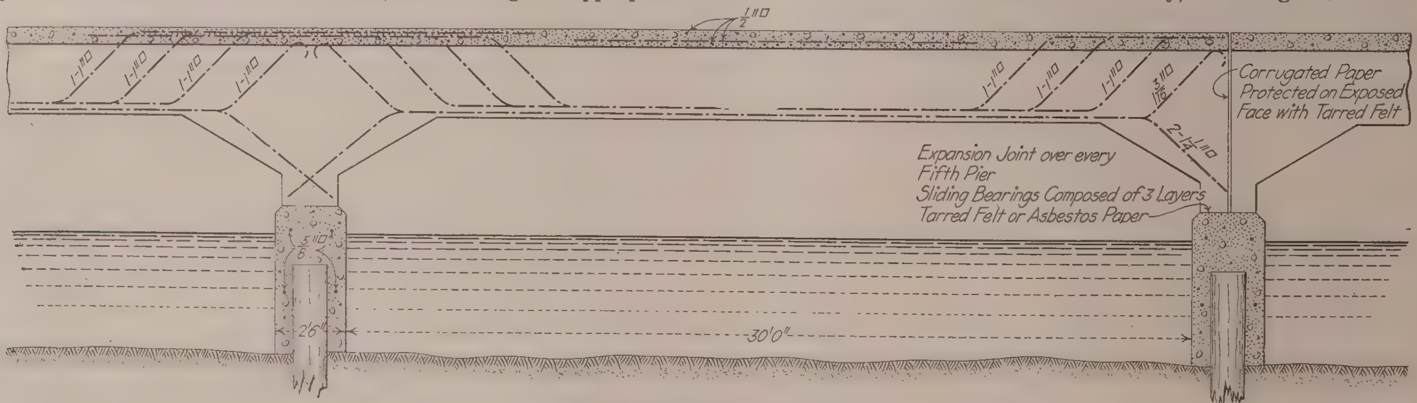
Arched Outlines Used for the 30-Foot Openings—Oyster Shell Fill Approaches 6200 Feet Long Protected by Brush Faggots and Riprap

By TERRELL BARTLETT

Of Bartlett & Ranney, Inc., Consulting Engineers, of San Antonio and Dallas, Tex.

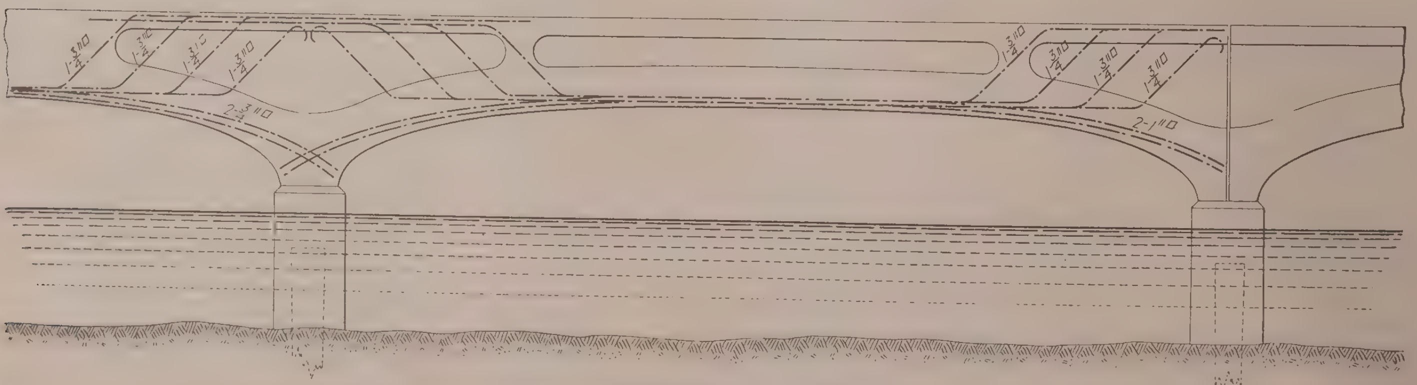
THE new Corpus Christi causeway, in Texas, containing 2500 ft. of reinforced-concrete girder spans, with 30-ft. clear openings, has arched outlines suggesting arch action. The girders were designed as continuous spans, with reinforcing provided above the piers to take negative bending moment. Low concrete piers on creosoted pile foundations, oyster shell fills with brush faggots and riprap protection for the long approaches, and a short bascule span are other features of a construction of exceptional economy, completed within the original appropriation.

The causeway, recently completed by Nueces County, provides a greatly needed highway between the city of Corpus Christi and San Patricio County and forms an important link in the system of roads connecting San Antonio and a number of the resort cities of the Texas Gulf Coast. The location map herewith shows the manner in which Nueces and San Patricio counties are separated by Nueces Bay. The lack of any direct highway communication between the rapidly growing city of Corpus Christi and the highly developed farming country in San Patricio County, including the famous



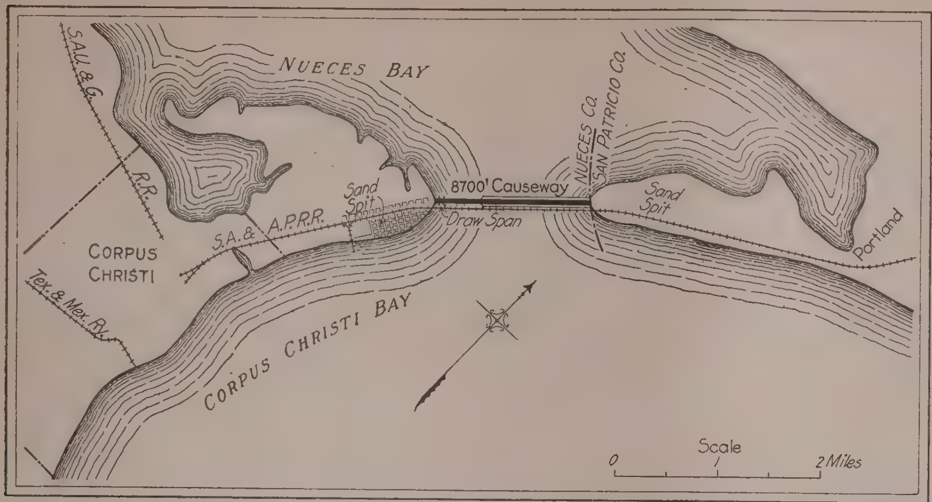
1-1"□
1-1"□
1-1"□
1-1"□
½"□
1-1"□
1-1"□
1-1"□
3/16"□
Corrugated Paper Protected on Exposed Face with Tarred Felt
2-1¼"□
Expansion Joint over every Fifth Pier
Sliding Bearings Composed of 3 Layers Tarred Felt or Asbestos Paper
5/8"□
2'6"
30'0"

REINFORCEMENT IN INSIDE GIRDER



REINFORCEMENT IN OUTSIDE GIRDER

ELEVATION OF INSIDE AND OUTSIDE GIRDERS SHOWS REINFORCEMENT, PIERS AND EXPANSION JOINTS



LOCATION MAP OF CAUSEWAY—NATURAL SAND SPITS AT EACH END

Taft ranch and the cities of Portland, Gregory, Taft, Rockport and Aransas Pass, has been a great obstacle to the development of the region.

The distance between the high land at Corpus Christi and that at Portland across the Bay is 7 miles, but two natural sand spits stretch out from either shore, so that the actual width of the neck of water connecting Nueces and Corpus Christi bays and which required bridging was 1 2/3 miles. The construction adopted consists of 6200 ft. of protected fill and 2532 ft. of short spans providing waterway for passing the tide waters and the floods of the Nueces River, which drains some 15,000 square miles. It includes a small lift span with 32 ft. clearance, as required by the Federal authorities for passing fishing boats and barges.

← FILL PROTECTED BY MESQUITE BRUSH FAGGOTS AND RIPRAP

→ SOUTH END OF CAUSEWAY WITH BASCULE LIFT SPAN

CONDITIONS AT SITE

At low water the depth along the line of the causeway varied from 6 in. to 2.5 ft. with a maximum known tide of approximately 2.25 ft. On the Corpus Christi Bay side, or east of the structure some 500 ft., there were exposed at extreme low tide a series of three sand bars, forming a continuation of the crescent shaped shore line of the two sand spits.

These and other conditions showed a tendency of the currents which have built out the two sand spits to continue this action and extend them, except as prevented by the opposing cross currents from floods and sudden tide changes, which have maintained the width of opening between the two bays. It was therefore believed that as soon as the cross currents were blocked by a fill across part of the waterway immediate shoaling of the water on both sides would occur, and would result in the formation of beaches along the structure.

The bridged portion, consisting of seventy-six reinforced-concrete girder spans, with 30-ft. clear openings, and the draw-span were placed at the south end where the deepest water existed, and provides a total waterway at high tide of 8600 sq. ft.

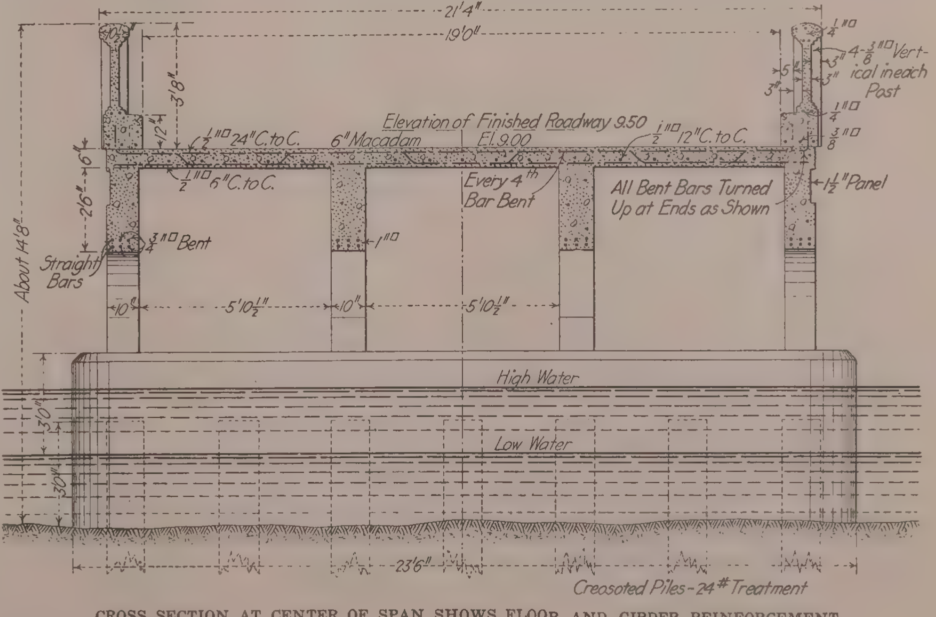
The piers consist of a bent of creosoted longleaf pine piling, 24 lb. treatment, with a concrete cap 2½ ft. wide extending down to the existing bottom. The top of the piers is at elevation 3.00 above low water datum. The concrete was placed in the water with a tremie. The piers are reinforced with four rods, two on each side of the row of pile heads, to avoid the danger of cracking opposite the piles.

The piles vary in length up to a maximum of 55 ft. They were driven to a penetration of ½ in. under a 6800 lb. gravity-drop steam hammer striking 60 blows per minute. Several piles were tested by applying a Watson-Stillman hydraulic press, which was in use on the job for testing concrete cubes. This press was inverted over the piles tested and pressure exerted on the pile against a counterweight composed of timbers. The piles showed no signs of starting under a load of 23.5 tons, the greatest which could be applied in the test, and which was substantially double the working load.

REINFORCED-CONCRETE GIRDERS

The spans are composed of four reinforced-concrete girders 32½ ft. center to center and 30-ft. clear span. The bottoms of the outer girders are in elliptical arch form, and the inside girders are corbelled. The girders and the concrete floor slab were run continuously through five spans; at every fifth pier the entire superstructure was completely cut by a contraction joint. The climate at Corpus Christi is remarkably equable, the mean temperature of the hottest and coldest months differing by only 29 deg. Fahr.

The roadway is 19 ft. 10 in. wide between concrete railings of ornamental type, the top of the floor slab being 9 ft. above low water datum. Details of the construction are shown in the drawings herewith; provision for continuity in both floor slab and girders is made by bending up the reinforcement as indicated. The roadway is drained by cast-iron gratings and scuppers

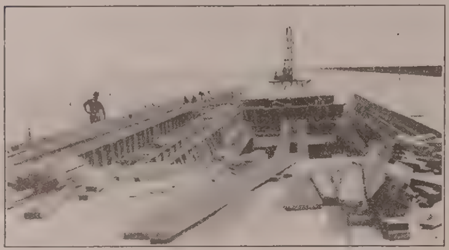


CROSS SECTION AT CENTER OF SPAN SHOWS FLOOR AND GIRDER REINFORCEMENT through the curbs as shown. A wiring conduit and anchor bolts were provided for future installation of light brackets over alternate piers.

CONCRETE AND FORM WORK

The concrete was composed of washed crystalline limestone gravel 1:2:4 mix, and was reinforced by deformed square rods of medium grade structural steel. A field testing laboratory was maintained throughout the work. Tests of 4-in. cubes of concrete for girders and floor showed an average strength of 2800 lb. per square inch at 30 days.

The forms for the spans were carried without falsework upon eight lines of 10 x 20-in. timbers 32 ft. long resting on the piers in pairs on either side of the four girders. The forms were composed of dressed lumber screwed together in panels and oiled. The panels were supported on the aforesaid timbers and held in position by a system of knockdown framing requiring no nailing, and wired only for the outer girder sides. The forms were used eight times with very little reworking.



PLACING PANELED KNOCKDOWN FORMS

The drawspan is of the Strauss bascule lift type, designed by the Strauss Bascule Bridge Company and fabricated by the Phœnix Bridge Company. The girders have a span of 42 ft. from center of main trunnion to bearing of moving leaf, and provide a clear span between fenders of 32 ft. The floor is a 4-in. slab of reinforced concrete carried on steel floorbeams and stringers and with 2 in. of trap-rock granolithic for the wearing surface.

OYSTER SHELL APPROACH FILLS

The approach fills, 200 ft. long at the south end and 6000 ft. at the north end, are composed entirely of oyster shell dredged from the shell reef which underlies the greater portion of the entire structure. The top width is 40 ft. and the side slopes 6 to 1, making a base of approximately 120 ft. width. A berm of 100 ft. was left between the toe of the slope and the dredge pits. The fill was dredged in to elevation 6.00 above low water and subsequently crowned to elevation 6.50 for the roadway.

The fill is protected by very shallow water on the west side; by a bar and by comparatively shoal water on the outer or eastern side fronting on Corpus Christi Bay. The anticipated shoaling action due to stoppage of cross currents as above mentioned has already developed to a noticeable extent. Although the fill is 30 miles inland from the Gulf of Mexico and is exposed to no severe storm nor wave action, it was thought best to supplement the protection from natural conditions by the following construction precautions: First, the use of oyster shell for building the entire fill; second, the adoption of very flat side slopes comparable to the slopes of the adjacent sand beaches; and third, by the use of brush faggots and riprap to protect the toes of the fill.

BRUSH FAGGOTS AND RIPRAP

The faggots consist of bundles of mesquite brush somewhat over 8 ft. long and 12 in. in diameter bound securely and tightly by four wire stays. These faggots were placed at right angles to the center line with brushy ends out and in continuous rows, simultaneously with the placing of the fill. Two rows of faggots were placed on the outer side and one on the inner side, except near the abutments, where three and two rows respectively were used. The fill, and especially the finer particles of shell, settled into the crevices of the faggots to form a solid toe. On top of the outer slope as thus constructed was placed the riprap composed of 50 per cent one man and 50 per cent two man stone placed by hand in an apron one layer thick and 14 ft. wide, as shown in one of the photographs. The heavier rocks were placed at the foot of the slope. Eighteen thousand faggots and 2600 tons of riprap were used.

The abutments and bulkhead wings protecting the ends of the fills at the junction with the bridge are of concrete extending down to the existing bottom and resting on creosoted bearing piles and a line of 6 x 12-in. creosoted sheet piles forming a continuous bulkhead.

ROAD SURFACE AND APPROACH

The road surfacing over the concrete slab is composed of a mat course of tarviated trap rock, and the surface of the shell fill after it becomes thoroughly compacted by traffic will be treated likewise. All materials for the construction of the bridge had to be imported from distances in excess of 125 miles.

San Patricio County has constructed simultaneously a 3-mile approach along the sand spit from Portland to the county line at the north end of the causeway proper. This work consists of a 4-ft. fill with 30 ft. crest and topped with 12 in. of shell. This has been surfaced with 2 in. of asphalted trap rock constructed by a modified penetration method known locally as the "Travilla Topping."

The San Patricio approach cost approximately $25,000. The cost of the causeway proper complete including road surfacing and engineering and inspection was $166,500. The causeway was constructed by Nueces County under the administration of the Honorable Walter F. Timon, County Judge. The preliminary studies and estimates, final designs and supervision of construction were by Bartlett & Ranney, Inc., consulting engineers, of San Antonio and Dallas, Texas, with Neal Hanson as resident engineer. The contractors were W. L. Pearson & Company, of Houston, Texas.

RAPID FILTERS AT FARGO, N. D., reduce the number of bacteria per cubic centimeter in the Red River of the North 98 to 99.5 per cent. In the raw water the counts range from 700 to 25,000, so states F. L. Anders, city engineer, in a paper presented recently to the North Dakota Society of Engineers. The hardness, which varies from 200 to 400 parts per million of carbonates, is reduced about one-half, making an estimated saving of $7,000 in the cost of soap. The treatment consists of 7 to 10 grains of lime per gallon, 1.3 grains of iron sulphate and 1/20 grains hypochlorite of lime.

First Unit of Jamaica Bay Improvement Completed

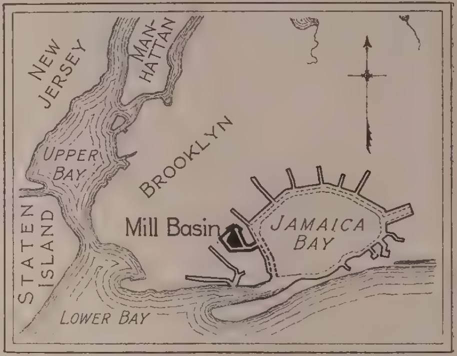
Mill Basin Development Gives Navigable Waterfront to 350-Acre Tract in Flatbush, 8 Miles from New York City Hall

THE DREDGING of Mill Basin, the first unit of the Jamaica Bay improvement, New York City, has been completed. By it a navigable waterfront has been given to 350 acres of level land considered ideal for industrial purposes, 8 miles from the City Hall on Manhattan. This tract, which lies between the two branches of the basin, is not bulkheaded, nor is it laid out into streets, the company which holds it preferring to sell or lease the land to the industries and allow them to develop it to suit their individual needs. Rail connection is at hand. In the estimation of the owners of the tract, the completion of Mill Basin marks an epoch, presaging the ultimate creation of a large and unexcelled industrial district bordering the waters of Jamaica Bay.

Jamaica Bay has been called New York's idle harbor. The accompanying map shows its relation to the city. It has an area greater than that of Manhattan Island, and adjacent to it are 9000 acres of unreclaimed land. The harbor is landlocked, but with an easy entrance. Rail connections are available. Agitation to utilize this harbor began some ten years ago, and led to a joint arrangement between the federal government and the city whereby the government would excavate the entrance channel around the bay, while the city would excavate the basins.

The channels are to be 18 ft. deep at first, ultimately to be increased to 30 ft. The entrance channel and the main channel around the bay are to be 500 ft. wide at first and enlarged as required to 1500 and 1000 ft. respectively.

To date the main channel has been dredged to its full depth as far as Mill Basin and the entrance channel to a depth of 14½ ft. at low tide. Mill Basin is 18 ft. deep throughout. Its channels vary in width from 150 to 500 ft., and a large turning basin is afforded at the end of the west arm. The dredging was done by the hydraulic method, the material being pumped upon the land, building it up to an elevation of about 6 ft. above high tide. Rail connection deemed ample for some time to come will be afforded by a line of the Brooklyn Rapid Transit Company, the preliminaries of which are now under way. This line connects at the Bush Terminal with all the trunk-line railroads terminating on New York harbor. As previously



RELATION OF JAMAICA BAY TO NEW YORK, AND LOCATION OF MILL BASIN stated, the policy of the company owning the land between the two arms is to dispose of the unimproved land and allow the industries which locate there to work out their own developments. Consequently the only improvements to date are the buildings, bulkheads, wharves and other facilities built by several industries that have already settled on the tract.

The dredging for both the government and the city has been done by the Atlantic, Gulf & Pacific Company, of New York City. It is this company also that owns and is developing the 350-acre tract at Mill Basin. Col. H. W. Stickle, vice-president of the company, is in charge of the development.

Illinois Highway Organization Fixes Responsibility

Chart Prepared to Indicate Definitely the Duties of Members of the Engineering Staff on State Road Work

So rapid has been the growth of the Illinois Highway Department since its organization in 1913 that it has been necessary to reorganize the force along permanent lines. The State Highway Commission consists of three members appointed by the Governor, having general control of the department. A state highway engineer, appointed by the Governor, is the executive officer of the commission. Such employees as are necessary to carry on the work of the department are appointed through competitive civil service examination.

The accompanying chart illustrates the organization as it has been adopted. The work of the department has been divided into five character divisions or bureaus with a bureau chief in charge of each of the five main divisions. These are respectively the bureaus of bridges, testing, maintenance, auditing and roads. The various bureau chiefs have responsible charge of all the work of the department of the particular character to which they are assigned.

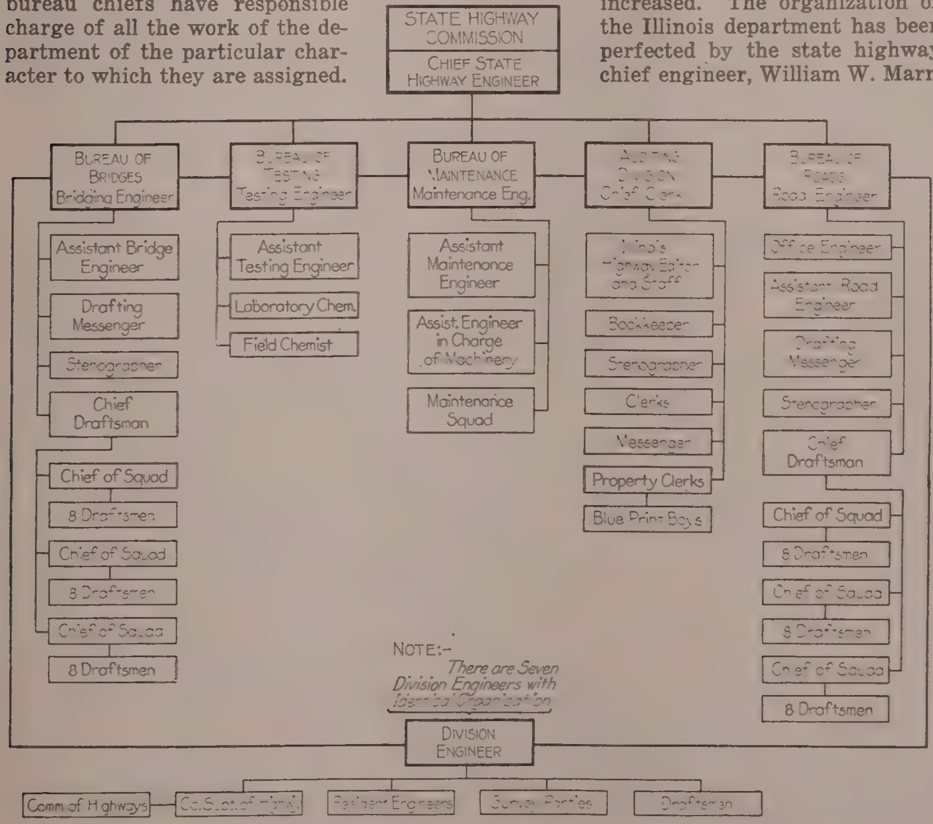
The work is further subdivided along territorial lines into seven districts, each under the direction of a division engineer, who is in direct responsible charge of all character of work in his district. The division engineers report to the respective bureau chiefs in accordance with the character of the work involved. Each division engineer is located in a permanent office in his division and has an independent organization of his own, reporting directly to him in all matters.

In addition to the division engineers, each bureau chief has reporting to him an independent office force for which he is directly responsible. There is in the organization no conflict of authority or division of responsibility. It will be noted from an inspection of the chart that no member of the department reports to or receives orders from more than one superior. The various assistants report to their immediate superior, and wherever an assistant has a specific branch of work assigned to him his subordinates report only to himself.

Responsibility Fixed

On the other hand, no member of the department is authorized to issue instructions to any but the immediate subordinates, which operates clearly and definitely to define authority and responsibility in all cases and to obviate the confusion which naturally results when a superior officer attempts to direct work over the heads of intermediate officials.

Owing to the vast territory in which the department operates and the scattered condition of the work, the overhead and engineering cost has been comparatively high in the past, but due to the establishment of division engineers in permanent quarters and otherwise perfecting the present organization, the cost of engineering has been greatly reduced and the efficiency of the men has been materially increased. The organization of the Illinois department has been perfected by the state highway chief engineer, William W. Marr.

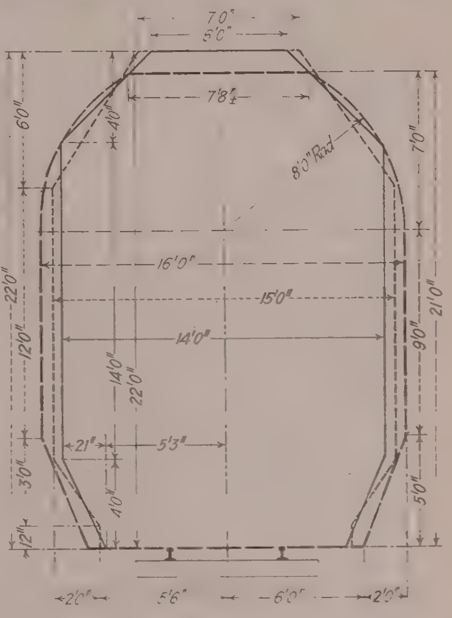


NO MEMBER OF THE DEPARTMENT MAY ISSUE INSTRUCTIONS TO ANY BUT HIS IMMEDIATE SUBORDINATES

Minnesota Commission Adopts Clearances

Issues Order Calling for 8 Feet Each Side of Center Line of Tangent Single Track for Bridges and Tunnels

In VIEW of the fact that the American Railway Engineering Association, after lengthy discussion at the convention last year, rejected the recommendation of the committee on iron and steel structures that the standard clearance width for single-track bridges on tangents be increased from 14 to 15 ft., the recent order of the Minnesota Railroad and Warehouse Commission, specifying a width of 16 ft., may be of interest. In the accompanying diagrams the full line represents the standard now in the *Manual* of the American Railway Engineering Association, the dotted line is that rejected last year, and the dash line is that adopted by the Minnesota commission. It may be noted that the Minnesota standard height above top of rail is 1 ft. less than that of the railroads.



CLEARANCE DIAGRAMS COMPARED

Full line, A. R. E. A. standard.
Dotted line, rejected by A. R. E. A. last year.
Dash Line, Minnesota standard.

The Minnesota order contains the same proviso as is found in the *Manual* of the American Railway Engineering Association—that the clearances shall be increased sufficiently to provide the same minimum clearances on curves for a car 80 ft. long, 14 ft. high and 60 ft. center to center of trucks, allowance being made for curvature and superelevation of rails.

The order applies only to bridges and tunnels, and does not state whether it is intended to affect such structures now existing with less than the standard clearances.

SPECIAL ASSESSMENT IMPROVEMENTS IN TEXAS cannot be forced on owners who have taken up property under the homestead laws. Hence many city streets in the state have short unpaved sections in front of homestead property. Karl Mitchell, city manager, Sherman, Tex., stated at the recent meeting of the City Managers' Association that a municipal improvement association had been formed in his city to loan money for such improvements to homestead property owners to be paid back later.

National Defense—For Engineer and Contractor

Third Article in Series Describing Army Methods for Stream Crossings by Ponton, Trestle and Truss Bridges Where Time Element Is All-Important Factor

By MAJOR P. S. BOND,
Corps of Engineers, U. S. Army

MILITARY field engineering, as we have seen in the previous articles of this series, is an adaptation of civil engineering and, in practice, differs from the latter in so far as it is governed by different economic principles and conducted under different conditions. Fortification works executed in time of peace are essentially similar to civil engineering construction, and the same is true of many engineering operations conducted in time of war on the lines of communication in rear of the fighting forces. On such works civilian engineers, without military training, may often be employed to advantage. We are now concerned, however, with field engineering, the pioneer operations of the fighting forces. Here we find a sharp contrast with civil practice. The conditions which govern the military pioneer may be recapitulated as follows:

THERE IS A REGULAR ROUTINE FOR PONTON CONSTRUCTION AND SO WONDERFULLY SIMPLE IS THE EQUIPAGE THAT UNSKILLED MEN CAN BE TAUGHT TO USE IT IN A VERY SHORT TIME

1. All works must be designed and executed to meet actual tactical needs. If constructed without due regard to the tactical situation they may be worse than useless.

2. A very large proportion of the works will be constructed to meet sudden emergencies. Opportunities to plan and carry out works a considerable time in advance of need, therefore, will be comparatively infrequent.

3. The fundamental economic principle of military engineering is that time is of the essence. Cost and durability of works are ordinarily matters of minor importance. The quickest makeshift is usually the best solution.

4. Simplicity must characterize all designs.

5. Materials which are available at or near the site of the work must be utilized to the fullest possible extent.

6. There will usually, but not always, be ample common labor available, but a dearth of skilled labor of all classes.

7. As a rule, no heavy construction plant and only the simplest tools and materials will be available.

The works resulting from these conditions are of a very simple nature. The highest expression of the skill of the military engineer is this very simplicity and the rapid adaptation of his designs to the tactical requirements of the situation and to the resources in men, tools, materials and the time at his disposal.

STREAM CROSSINGS

The ability to cross streams is essential to the mobility of the army. To facilitate such passage is one of the chief duties of the engineers. The history of war is replete with examples of delays and failures due to the lack of equipment for the rapid construction of bridges.

On Jan. 26, 1814, Napoleon writes: "If I had had ten pontons I should have captured 10,000 wagons, beaten Prince Schartsenburg in detail, annihilated his army and closed the war; but for want of proper means I could not cross the Seine."

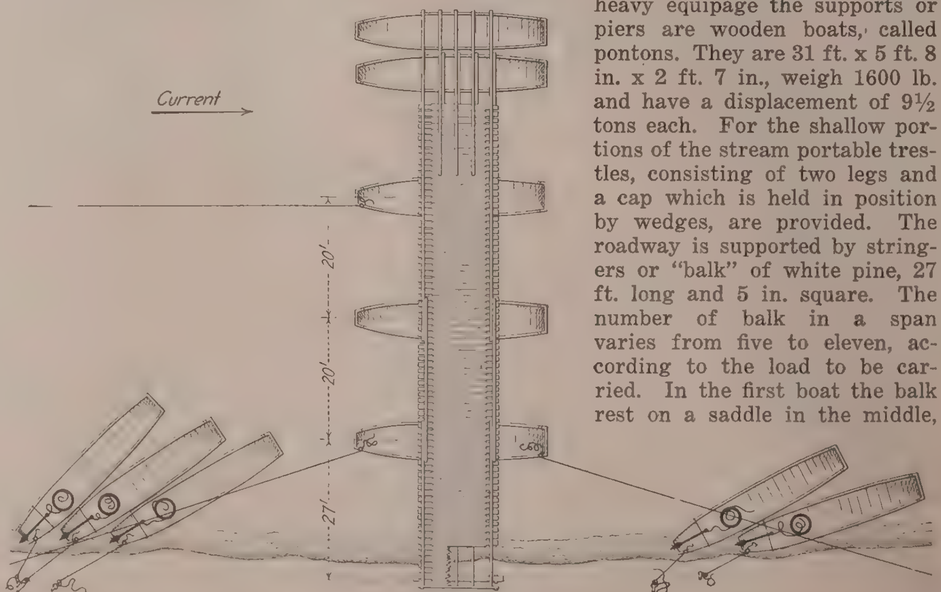
Writing to the Adjutant General under date of May 18, 1846, General Zachary Taylor says: "My very limited means for crossing rivers prevented a complete prosecution of the victory of the 9th (Palo Alto). A ponton train, the necessity of which I exhibited to the department last year, would have enabled the army to cross on the evening of the battle, taken this city, with all the artillery and stores of the enemy, and a great number of prisoners—in short, to destroy entirely the Mexican army."

The passage of streams is so very important and necessary that the mobile army cannot afford to rely entirely upon makeshifts improvised from materials collected at the site, as the quotations above will show. Indeed, in the case when a large army with its heavy trains is confronted with a wide and deep crossing, the construction of an improvised bridge might require weeks of time. The shifting tactical requirements do not wait on such delays, and to meet such situations some form of portable bridge with floating supports is absolutely necessary. Accordingly, all modern armies carry such bridges, which are known as ponton equipage.

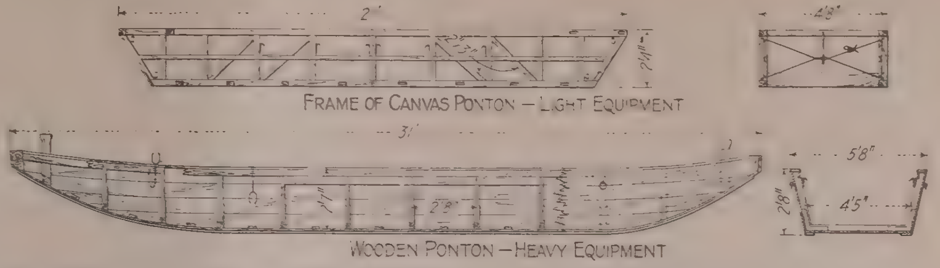
The equipage in use in our army was devised prior to the Civil War and used with conspicuous success throughout that great conflict. It is a tribute to the wisdom of those who devised it that in over fifty years no radical changes have been made. The equipage is one of the simplest and most cunning of military expedients.

LIGHT AND HEAVY PONTONS

There are two forms of the equipage, known as the heavy and the light. In the heavy equipage the supports or piers are wooden boats, called pontons. They are 31 ft. x 5 ft. 8 in. x 2 ft. 7 in., weigh 1600 lb. and have a displacement of 9½ tons each. For the shallow portions of the stream portable trestles, consisting of two legs and a cap which is held in position by wedges, are provided. The roadway is supported by stringers or "balk" of white pine, 27 ft. long and 5 in. square. The number of balk in a span varies from five to eleven, according to the load to be carried. In the first boat the balk rest on a saddle in the middle,



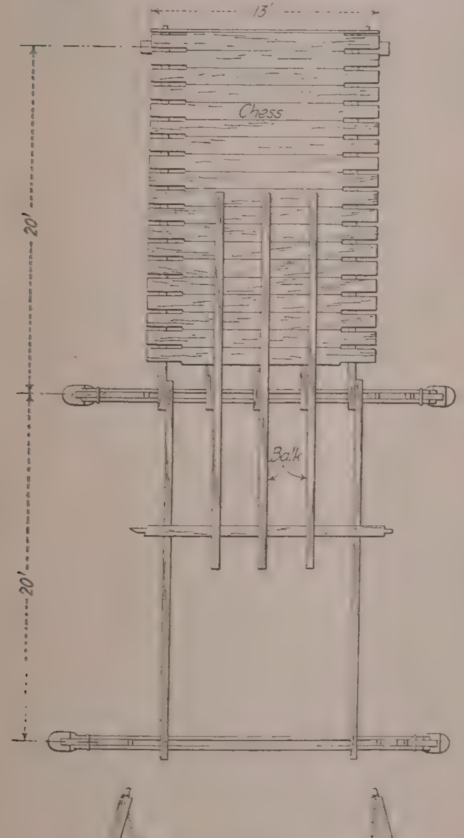
THE MOST COMMON METHOD OF PONTON BUILDING IS BY PUSHING OUT SUCCESSIVE BOATS FROM SHORE which forms a hinge to allow for changes in the level of the water. In the other boats the balk rest on the gunwales. All fastenings are by means of lashings. The deck consists of plank 1½ x 12 in. by 13 ft., of white pine, called "chess." They are held in position by side rails laid on the deck at its edge and lashed at intervals to the balk below, the lashings passing through notches in the plank. The pontons are held in position by a system of upstream and downstream anchors. The distance from center to center of supports is 20 ft.


2'
4'8"
2'4½"
FRAME OF CANVAS PONTON — LIGHT EQUIPMENT
31'
2'7"
2'8"
5'8"
2'8"
4'5"
WOODEN PONTON — HEAVY EQUIPMENT

THE WEIGHT OF THE HEAVY PONTON EQUIPAGE, NOT INCLUDING THE WAGONS ON WHICH IT IS TRANSPORTED, IS ONLY 169 POUNDS PER RUNNING FOOT OF BRIDGE—THE LIGHT PONTON IS A WOODEN FRAME BOAT COVERED WITH WATERPROOF CANVAS; IT CAN BE DISMANTLED FOR TRANSPORT

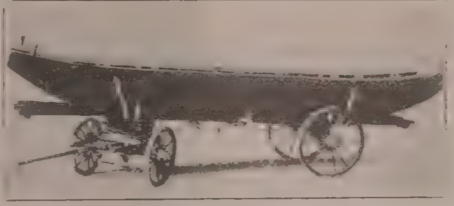
The light train is similar to the heavy, except that the ponton boats consist of a framework covered with heavy waterproof canvas and can be dismantled for transport. They have a buoyancy of 6 tons. The balk are shorter and lighter, the span between supports is 16 ft., and the roadway narrower. The two trains may be combined in one bridge.

This material is all transported on wagons and is sufficiently mobile to accompany the troops on the march. The light train can keep pace with cavalry. The ponton bridge roadway will support, with a factor of safety of four, the heaviest loads that accompany the army. This bridge can be laid, crossed and taken up in far less time than any other form of bridge ever devised can be constructed. The weight of the heavy equipage, including the wagons on which it is carried, is 315 lb. per running foot of bridge; of the light equipage, 275 lb. Not including wagons, the weights are 169 lb. and 128 lb. respectively. It will be interesting to compare these weights with those of other forms of bridge of equal capacity.



THE SIMPLE TRESTLE BRIDGE IS ADAPTED TO A WIDE VARIETY OF USES

There is a regular routine for construction, and so wonderfully simple is the equipage that unskilled men can be taught to use it in a very short time. The bridge may be constructed by pushing out successive pontons from one or both banks, by constructing parts along shore and floating them to position, or by constructing the entire bridge along the bank and then revolving it into position. The first method, known as "successive pontons," is the one usually employed. The procedure, as laid down in the "Engineer Field Manual, U. S. Army," is as follows: In a trench the abutment sill is laid perpendicular to the bridge axis and secured by pickets, two at each end. If necessary, one or more trestle spans are then placed and the first floating support is brought to the bank opposite the abutment. The free ends of cables fastened to the bank 30 paces above and below are passed to men aboard the pontons. A set of balk is brought up and the cleats engaged on the saddle of the ponton and lightly held by lashings. The ponton is pushed off until the cleats at inner end of balk engage the abutment sill and the mooring lines made fast. The balk are then lashed securely to the saddle and the chess (deck plank) laid. The next ponton is then brought alongside and its anchor lines (previously placed by another boat) passed aboard. The operations are repeated until the other shore is reached. The bridge is dismantled in reverse order. If the bridge is to be in position for some time a movable section or draw may be placed in the middle to allow the passage of vessels, drift, etc. The draw consists of two boats with a span of decking between.



PONTON MOUNTED ON WAGON

The construction of these bridges is one of the most picturesque and interesting of military operations. The adaptability of the equipage is very great and improvised floating supports, such as boats, rafts and casks may be used to supplement the regular equipment.

"BRIDGES OF CIRCUMSTANCE"

While great reliance will be placed upon the ponton equipage, it cannot entirely obviate the necessity for hastily constructed bridges of other types, which must frequently be improvised from materials found near the site. Such bridges are known as "bridges of circumstance." Considerable skill on the part of the engineer officers will be required to adapt the bridge to the site and materials available to produce the quickest results. The construction of a bridge is an interesting task, and there is a strong tendency to put in a bridge when a reconnaissance a little up or down stream would have revealed a practicable ford, or to build a bridge at a site where an improved ford with suitable approaches would have served the purpose at a far less expenditure of time.

The engineer confronted with a stream crossing seeks first a practicable existing bridge and in contemplation of a movement of troops all important bridges that may be used should be seized in advance to prevent destruction by the enemy or his sympathizers. Even if the bridge is insufficiently strong or has been damaged it can often be repaired or strengthened in less time than a new bridge could be built.

SIMPLE TWO-LEGGED TRESTLES

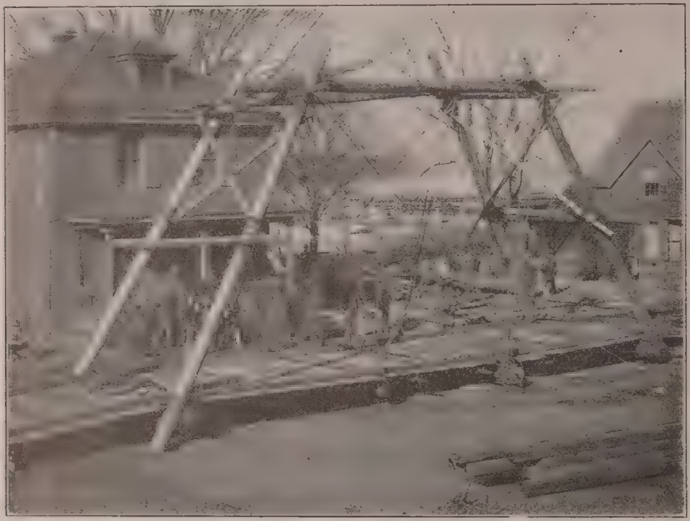
The number of types of these improvised bridges is naturally very great, but a few of them have been found specially adapted to military uses. The most common type is the simple two-legged trestle, frame or pile, which can be adapted to a great variety of conditions. The relative time and difficulty of constructing the piers and spans will fix the economic length of span. For military purposes this will usually be 10 to 15 ft., and for such a span longitudinal bracing will usually be unnecessary. But if the water is very deep or the banks high, so that large trestles are required, it will often be better to reduce their number and increase the span, employing more stringers or some form of light truss. To reduce the size of trestles the approaches may be cut down. In selecting a site the time of construction for bridge and approaches should be considered. Ordinarily a locality where the stream banks are low and firm and of equal height with a short span will be the best site. If the depth be moderate and the bottom firm the framed trestle will be best. If necessary a mud sill may be used to increase the bearing power, and if the depth is considerable or the current swift the trestles may be weighted down by boxing their sills and filling with stone.

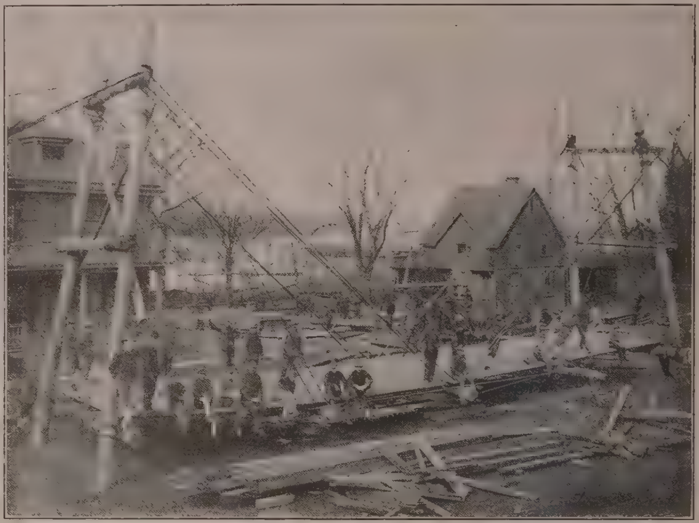
While the two-legged trestle is the favorite type, three- or four-legged (sawhorse) trestles may be employed. Cross-bracing of trestles is always necessary, and for long spans longitudinal bracing may be required. For very high trestles two or three stories may be used. Almost any materials can be utilized for trestle bridges; even bamboo has been successfully employed to carry heavy loads. In considerable depths with a soft bottom pile trestles are often to be preferred. A hasty pile driver may be improvised with a heavy block of wood raised by tackle and guided by a "spider" and a few upright poles. Of course, a light, portable power driver or hammer will be very useful in such situations, if available.

For very soft, yielding bottoms, especially if suitable piles are not available, simple log cribs filled with stone, if necessary, may be employed in conjunction with trussed spans.

TYPES OF TRUSS BRIDGES

The purpose of trusses is to reduce the number of supports. In military field operations the use of trusses will usually be limited to situations where they can be placed with the aid of animals and tackle and without falsework. If it be necessary to place falsework, this will usually serve to carry the deck and no truss will be needed. If the bridge is to be used for some time and there is danger from flood or ice, large trusses may be placed. Such work would seldom fall to the lot of the pioneer engineer troops. An excellent example of a large military truss bridge is that built over the Kansas River at Fort Riley, Kan., by the Third Battalion of U. S. Engineers and described in this journal July 11 and 18, 1908. The usual forms of truss will be the simple king-post (or triangular truss) and queen-post, erect or inverted, with tension members of iron rods or steel cable. Small Howe or Pratt trusses and lattice or bow-string girders of plank spiked together are often employed. The difficulty of placing trusses without the aid of plant ordinarily limits their span to about 40 ft., the larger trusses being built in place when practicable. Under special conditions, as where the truss may be floated to position on a barge, greater spans may be practicable. In many situations the spar lock bridge, which in double lock is practicable up to 45-ft. span, may be constructed more easily and quickly than a truss. The supports of this type consist of two tall trestles erected on or near the bank and tilted over until their heads lock amidstream, forming a point of support. This is called single lock. In double lock the trestles are tilted until they lock with a frame placed between them, this frame forming one central span. This type has peculiar advantages from the military point of view, as where applicable it can be quickly constructed of rough materials.





BRIDGES OF THE DOUBLE LOCK TRESTLE AND SUSPENSION TYPES; CONNECTIONS MADE BY ROPE LASHINGS; ELABORATE FRAMING IS AVOIDED

SUSPENSION BRIDGE METHODS

Clear spans of more than 50 ft. should usually be avoided by seeking a more favorable site. When such cannot be found a suspension bridge will usually be the only type which will meet military requirements and, for moderate loads, is practicable for long spans. The essential part of a suspension bridge is the cables, and if these are available the balance of the material is usually readily obtained. A great variety of materials have been employed for cable, including manila rope, chains, bamboo, etc. The best material for cables, of course, is wire rope, and when the necessity for such bridges is possible a supply of rope with fittings should be carried by the engineers. Adjustable suspension rods or hangers may also be provided in advance—cable will serve this purpose. On account of the difficulty of handling and fastening large cables they should be limited to ¾ or 1 in., multiple cables being used when necessary.

The first step in construction is to erect the towers and prepare the anchorages for the cables. The towers will usually be of timber and of the saw-horse trestle type, to resist overturning both during construction and subsequently, as no roller bearings are employed and vertical reactions cannot always be insured. Standing trees may occasionally be utilized for towers. The anchorages consist of large logs in trenches (dead-men), standing trees or stumps, large boulders or ledges of rock, where available. Occasionally concrete is employed. The cable may be dragged across the towers or laid out, measured and anchored (temporarily, at one end, to allow adjustment) on the ground and then lifted to the towers. The sag of the cables will usually be considerable. This decreases the strain on the cables, but make the bridge very liable to undulation under live loads. Slings or suspension rods may be cable, wire rope, manila rope, round iron, or even wood. From each pair of slings hangs a transom or roadway bearer, on which the stringers and deck are placed. Oscillations and undulations may be controlled by lateral trussing of the roadway, by a trussed guard rail, by drawing the cables together at the center of the span, and by guys.

In many situations a combination of types meets requirements better than any single type. Such combinations might include frame and pile trestles, trestles and truss spans, a combination of trestles and floating supports, the latter being a very usual expedient. The deck or roadway should be no wider than necesary, both because of the weight and extra time required for construction. Ordinarily two lines of vehicles will not be passing in opposite directions at the same time. Twelve feet is usually quite sufficient for a wagon bridge, allowing for the passage of infantry or horsemen alongside the wagons. For a foot-bridge alone a less width is required. Side rails are always provided, but hand rails are seldom used except on through truss and suspension bridges.

The stringers may be of round or sawed lumber. Planking 1½ in. or more in thickness makes the best deck. Where this is not available the deck may be of poles held in place by side rails and covered with brush, leaves and earth or gravel. This makes a satisfactory deck, but, except in short span trestle bridges, is objectionable because of its weight. The fastenings are of the simplest nature, lashings, spikes and bolts being used. Elaborate framing is avoided so far as possible.

LOOK FOR FORDS FIRST

Before entering upon the construction of a bridge search should be made for a practicable ford, if the nature of the stream gives any promise that such may be found. Fords which have been used by the local inhabitants should be first examined. In determining the practicability of a ford the considerations are: (a) Nature of approaches; (b) nature of bottom; (c) depth of water, and (d) velocity of current. For the passage of mounted troops and wagons the approaches may be improved by cutting down the banks to ease the grades and by surfacing the roadway with plank, brush, gravel, etc. A sandy bottom is the most favorable and usually requires no improvement. If the bottom be rocky or yielding it may be made practicable by a deposit of sand or gravel, by fascines or bundles of brush, or by a woven mattress sunk in position.

The limiting practicable depths of fords where the current is sluggish are: For infantry, 4 ft.; for cavalry, 5 ft.; for artillery or wagons, 2½ ft. If the current is swift the depths for infantry and cavalry are 3 ft. and 4 ft. respectively. A life line may be stretched across the stream to facilitate the passage of infantry. Ice 2 in. thick will support infantry in single file; 4 in. thick, cavalry at intervals; 5 to 6 in., heavy field pieces.

IMPROVISED FERRIES

When fording is impracticable and there is not time nor material for a bridge, resort may be had to a ferry. These will be used especially in cases of wide crossings, where time is of special importance and when the number of troops to cross is small. The ponton equipment heretofore described is specially designed with a view to its use for ferrying purposes. The pontons of the heavy train will carry from twenty to forty foot troops in addition to the crew. A raft or cattamaran made of two pontons, with a span of flooring between, will carry cavalry, artillery and wagons. In the absence of the ponton equipment rafts may be constructed of logs, casks, etc.

If the current be swift a rope may be stretched from bank to bank and the float drawn across by hand. Or the current may be made to furnish motive power by attaching a block to the rope and securing the float to the block in such a manner as to hold it at an angle to the current. In the flying bridge the float is attached to and swings in a circle on a line anchored well upstream. The current may be made to furnish motive power, as in the former case, or the ferry may be drawn across by an auxiliary line secured to the bank.

SIMPLE PILE TRESTLES ARE USED EXTENSIVELY IN MILITARY WORK

SUSPENSION BRIDGES ARE BEST FOR CLEAR SPANS EXCEEDING 50 FEET

[*Next week—"Field Fortifications," including trenches, bombproof shelters, tunnels for subterranean attack, barbed-wire entanglements and other forms of obstacles.* —Editor.]

WATER COMPANY METER ADVERTISING in Terre Haute, Ind., is being carried on extensively since the readjustment of rates by the Public Service Commission. One of the recent newspaper advertisements showed a pyramid of 2½-gal. buckets of water with the caption "Forty buckets—pure filtered water—2 cents. Monthly minimum—60 cents for 3000 gal. Can you afford to pump and carry forty buckets of water for 2 cents?" To promote the use of meters a series of six anticipated questions are answered in literature distributed to prospects. Another set of twelve questions and answers was sent to 2200 customers whose services the directors decided to meter. These consumers had sprinkling connections, washed automobiles, used water in stables or kept boarders. Meters, set at the curb, are being put in free by company gangs working from house to house.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Urges Pressure on Congress for Real Military Legislation

SIR: Engineers everywhere appear to be fully awake to the needs of this country for defense and to be anxious to equip themselves for their part in a general scheme of mobilizing the country's human and material resources for this purpose. It seems to the writer, however, that engineers and others are failing tragically to put proper emphasis on the necessity for the most vigorous organized activity in spreading their knowledge and beliefs, and urging upon Congress the principles which, judging from the spontaneous applause at the military lectures for engineers, are unanimously concurred in as a basis for preparedness. The more important of these principles, as the writer interprets them, are as follows:

(1) A large navy and an adequate standing army.

(2) Universal compulsory training for all males, beginning with athletics and use of rifle for boys, and broadening to include formal military training for youths and young men; no subsidy of, or reliance on, militia and volunteers for national defense.

(3) Defense plans to have the approval of our military experts. These plans should not be the products of presumptuous amateurs.

(4) Organization of all industries, means of transportation and communication and creation and safeguarding of supplies of chemicals and special steel alloys without which ammunition and armor cannot be made, and for which the country is now largely dependent on hand to mouth import.

Engineers may cheer these principles and study and drill and go to Plattsburg until they are gray, but they might as well be on Mars for all the impression they will make on legislation by these actions alone. Engineers are not politically significant; one ward leader in city politics might easily wield more influence on the vote in Congress than all the engineers who attend lectures in New York unless engineers organize to spread and enforce their beliefs.

The same is true in nearly equal measure of the half dozen or more security societies. The mail is so full of circulars of different societies calling for subscriptions of amounts of $1 to $1,000 that the ordinary recipient becomes confused and throws the documents into the waste basket. In the opinion of the writer these organizations should be combined or federated, and should pursue a campaign as vigorous as will the two national parties in the coming presidential election. Some political managers are needed, and engineers as well as others should consider it more important to assist the political propaganda than even to train themselves at the present time.

Those who read the doings of Congress know that there is no military bill in likelihood of present consideration, not to speak of enactment, that begins to comply with the principles which engineers apparently accept as indispensable. Unless the people at large can be convinced of the correctness of these principles, and Congress made aware of it, other more articulate ideas will prevail, the present interest in defense will wane—barring war—the opportunity to pass a broad unbiased scheme will be lost, and the nation will settle down again to slackness, and all the training of engineers come to nought.

THOMAS H. WIGGIN.

New York City.

Do Wooden Piles Fail?

SIR: Within the experience of the writer, covering a period of upwards of thirty years, he has never known or heard of an instance of wooden piles in building foundations failing, due to deterioration, if they were entirely below the soil. Will you kindly take the question up in the columns of the Engineering Record for the purpose of obtaining information on the subject.

ROBERT J. REIDPATH & SON.

Buffalo, N. Y.

Unbiased Specifications for City Pavements Wanted

SIR: I wish to second the motion, made editorially in your issue of Jan. 29, for a committee of the American Society of Civil Engineers to investigate pavements and to draw up specifications therefor. Millions of dollars are being spent annually in the construction or reconstruction of city pavements. Much of this work is being done to-day on the basis of specifications prepared by manufacturers interested in promoting the use of various classes of materials. While these manufacturers are, of course, interested in securing the best results for their respective materials, there are many questions on which they are precluded from rendering an expert opinion because of their special bias.

In this city I have been endeavoring to devote as much time as possible under existing conditions to studies looking to the improvement of paving methods, and I believe have secured some results which are of value. I should welcome most heartily, however, such an investigation by a trained and competent body of engineers. Such a body should be furnished with the means to make their studies thorough and complete.

I trust that some action may be taken in the near future by the American Society of Civil Engineers looking to the appointment of such a committee. There are undoubtedly many other topics which might be investigated, but I believe the one which you have mentioned is of such large importance that the work should be begun as speedily as possible.

A. H. DIMOCK,
City Engineer.

Seattle.

Decimals of the Degree and the Quadrant as a Unit

SIR: I have been expecting to see some one come forward with the following suggestion: Adopt the quadrant or right angle as our unit of measurement of the difference of direction between two lines; then divide that decimally. This seems to be a logical method, for we now use the right angle loosely as a unit and 1/100 of a right angle would be about the same size as our present degree.

Any convenient symbol could be adopted for the right angle unit, such as *R*, although there is no real need of any symbol at all. The numerical value will have one figure to the left of the decimal point as a characteristic indicating in which quadrant the angle falls. Furthermore, there is no reason why the common fraction cannot be used. Assuming, for the time being, that *R* is adopted as the symbol of the right angle unit, 30 deg. appears as 0.3333 *R;* 108 deg. as 1.200 *R;* and 198 deg. as 2.200 *R*, etc.

It may be offered in objection that seven or eight decimal places are necessary to indicate seconds, but this could be no worse than giving an angle in degrees, minutes and seconds and then trailing along with several decimals of seconds. If desired, the number of decimal places could be reduced by two by taking 1/100 of a right angle as the unit, just as the centimeter is used as a unit of measurement.

EDWARD M. WALKER,
Secretary-Treasurer, Detroit Engineering Society.

Detroit.

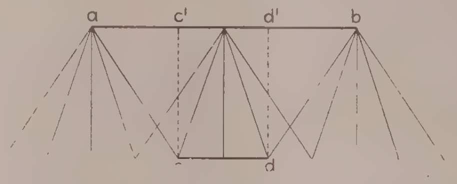
Distribution of Vertical Pressure Through Sand

SIR: The following comment is pertinent to the interesting article by Professor Enger of the University of Illinois on "High Unit Pressures Found in Experiments on the Distribution of Vertical Loading through Sand," published in the Engineering Record of Jan. 22, page 106.

The work done at the Pennsylvania State College Engineering Experiment Station was under Prof. R. B. Fehr, who is the author of the following statement:

Professor Enger's experiments on the relation between the loading and weighing area give very interesting data, which unpublished experiments here corroborate in a general way.

The accompanying diagram explains why the unit pressure of the smaller weighing area may be greater than that of the loading area. Each point in the loading area *ab* may be considered as a center from which extend diverging lines of pressure through the earth, according to our common knowledge of the distribution of earth pressure. It is, therefore, reasonable to suppose that in the case of an earth fill of only 6-in. thickness which would transmit a high percentage of the applied load, a smaller area lying directly under the load would receive not only its share of the lines of pressure from the projected area overhead *c′d′*, but some additional lines of pressure from the area *ac′* and *d′b*.



For measuring the percentage of load transmitted to a co-axial area below, circular loading and weighing areas are theoretically preferred. Practically, however, the writer's tests indicate that the shape of these areas does not cause any material difference in the percentage transmitted so long as they are of the same shape and size. For simplicity of construction and ease in varying the size of the opening in the floor of the test box, the square was adopted in the Pennsylvania State College tests.

Undoubtedly the best method for obtaining accurate data on the distribution of vertical pressure would be to vary the size of the lower circular area and to obtain the variation of vertical pressure by the method of differences. By this method of co-axial conical frusta one could readily obtain the integral effect of the vertical pressure on concentric circles, and the distribution of the vertical unit pressure would then be a matter of simple calculation. This method, however, would entail considerable time and expense, and since the simpler method of varying the position of the loading area back and forth appeared to give consistent results, which would be of practical use, the latter was adopted by the Pennsylvania State College Engineering Experiment Station.

Finally, it is desired to call attention to the superposed curves of Professor Enger's Figs. 3 and 4. It must be kept in mind that these curves are not comparable, as they represent the results of two different ratios of loading and weighing areas. Objection is made to Professor Enger's statement that the "Pennsylvania experiments have one inconsistency in common with those of Illinois—the sum of the upward pressures under a 6-in. layer of sand exceeds the sum of the applied load and weight of the sand." In the Pennsylvania experiments the pressure due to weight of the sand was practically eliminated by taking an initial dead-load reading of the scale. The values obtained are therefore percentages of transmission of the external live load only.

Furthermore, an error was made by Professor Enger in transposing the curve for the 6-in. depth from the Engineering Record of March 13, 1915, page 330. For example, at 12 in. from the center the per cent transmission should be only 5, whereas he shows it to be 13. The original data for the 6-in. depth of sand indicates that the pressure is transmitted to a point about 52 in. from the center of the loaded area. The average percentage transmission over this span of 104 in. amounts to 11.9, which, multiplied by 8 2/3 ft., gives a total vertical pressure of 103.2 per cent of the applied load. Experimental errors in this kind of work are necessarily of such magnitude that this excess, 3.2 per cent, should not be regarded as an inconsistency.

R. L. SACKETT,
Dean of Engineering and Director of Engineering Experiment Station, Pennsylvania State College,
State College, Pa.

[The foregoing letter was submitted to Professor Enger, whose reply follows.—EDITOR.]

SIR: An error was made in transposing the curve representing the Pennsylvania experiments for the 6-in. layer of sand, as was stated by Professor Fehr. Because of the scale of the drawing the correction causes a very small change in the appearance of the curve.

Professor Fehr's calculation of the upward pressure under the 6-in. layer of sand seems to be in error. He does not state how the average transmission of pressure of 11.9 per cent was obtained, but this figure seems to represent the average height of the curve for the 6-in. depth of sand published in the Engineering Record of March 13, 1915, page 330. Dividing the area of the base by a series of concentric circles 1 in. apart and using the average pressures from the curve, it can be shown that the upward pressure as given by the Pennsylvania experiments exceeds the applied load by more than 40 per cent. The upward pressure within 10 in. of the axis of the applied load is equal to the applied load.

The fact that pressure was measured on the plug when it was 52 in. from the center of the applied load indicates that the floor of the box carrying the sand deflected, thus throwing a load on the more rigidly supported plug. Experiments made at the University of Illinois, in which three forms of measuring devices were used, have never indicated vertical pressure much outside of a line drawn downward on a 1:2 slope from the edge of the loaded area.

MELVIN L. ENGER,
Assistant Professor of Mechanics and Hydraulics, University of Illinois.
Urbana, Ill.

HINTS FOR THE CONTRACTOR

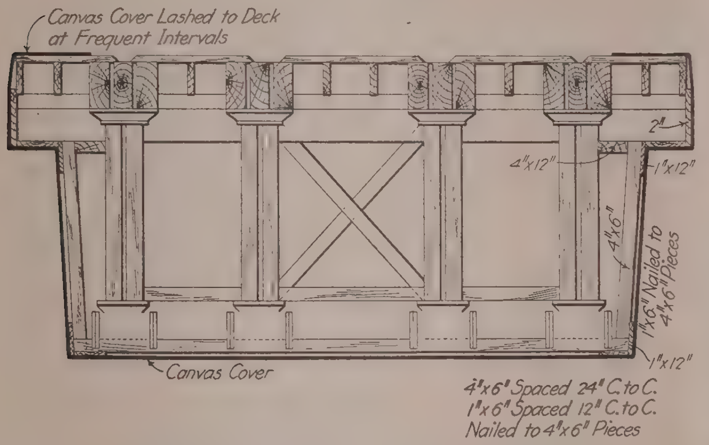
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Canvas Over Timber Frame Converts Ferry Apron Into Ponton

USING 7000 ft. b.m. of timber and a huge sheet of canvas, the 110-ton ferry apron shown in the accompanying illustrations was converted into a ponton by U. S. Army engineers and transferred a mile and a half to a new location at Humboldt Bay, Cal. The apron had been used for transferring cars loaded with fill for rebuilding the south jetty at the entrance to the bay, and was, with the rest of the construction plant and buildings, transferred across the entrance on the completion of the south jetty for use in rebuilding the north one. The entire moving operations are described by George F. Whittemore, junior engineer, in *Professional Memoirs* for March-April, 1916.


Canvas Cover Lashed to Deck at Frequent Intervals
2"
4"x12"
1"x12"
4"x6"
1"x6" Nailed to 4"x6" Pieces
1"x12"
Canvas Cover
4"x6" Spaced 24" C. to C.
1"x6" Spaced 12" C. to C.
Nailed to 4"x6" Pieces

SECTION THROUGH APRON SHOWING CANVAS COVER

The apron weighed 67 tons submerged, and had to be moved to place endwise between the foundations for the counterweight towers for its outer end, already constructed at the new location. The problem of moving the apron and supporting it until the counterweight towers could be transferred was solved by the scheme described, which was devised by Lieut.-Col. Thomas H. Rees, engineer officer in charge of the district.

The canvas, No. 6 duck, was made into one piece, 48 x 120 ft., one side of which was treated with two coats of hot paraffine to make it more watertight. The wooden frame built around and under the apron to support this canvas consisted of 4 x 6-in. ribs on which were nailed 1 x 6-in. strips. The ribs were spiked to 4 x 12-in. timbers, which in turn were spiked to the needle beams of the ferry apron. This frame was built at odd intervals because of the tides and the fact that the apron was being used to unload stone cars. The work began June 19 last, and was finished by July 24, on which day the apron was raised clear of the water, a heavy accumulation of seaweed removed from it, and the canvas put on. The canvas was rolled up longitudinally on the deck of the apron, one end tied to the deck and the pulling end made fast to a raft of old timbers. The raft, which served to keep the canvas up and the water out, was then drawn under the apron by a launch and three rowboats, carrying the canvas to place with it. When the edges of the canvas had been firmly tied to the upper deck, the apron was unfastened at the shore end and anchored to the wharf and to deadmen on the beach. Meanwhile, a 20-ton crane had been loaded on a barge to handle the counterweights and towers. On July 26, after the holding-back frame had been removed to the new approach, all water was taken out of the ponton with two hand pumps. The leakage through the canvas was small. When the apron floated as the cables were unclamped from the arch just before starting, a 6-in. hole was torn in the canvas at the outer end. This leak was quickly stopped by throwing an emergency sheet of canvas over it. The ponton was then shoved out carefully by hand from between the towers and made fast to a barge on each side. Though it was thought that the apron could not sink in any case with this arrangement, an air-tight oil barrel was attached to each of the four corners by 50 ft. of cable, so that if the craft met with an accident its location and raising would be easier. Two tugs towed the outfit to the new site across the channel, which was roughened by a high northwest wind. The apron rode high, drawing only 3 ft. 10 in., and chaffed badly along the sides. Although rope fenders were plentifully used, several small holes were made in the canvas above the water line. It took 50 minutes to tow the apron across and 10 minutes at each end to shove it out and to place it between the towers.

FERRY APRON WEIGHING 110 TONS WAS TRANSFERRED TO NEW SITE AT 2 PER CENT OF ITS COST BY MAKING A PONTON OF IT WITH THE AID OF HUGE SHEET OF CANVAS STRETCHED OVER TIMBER FRAME

After the apron was clear of the old towers, these were dismantled and landed on the crane barge, by which they were taken across and re-erected at the new site. This work was completed by July 30, when the apron was again suspended from its hinge and cables, and the canvas cover removed. The total cost of making the move was $1,330.28, which represented about 2 per cent of the original cost of the apron.

Lead Wires Measure Clearance in Adjusting Big Pump Bearings

By GEORGE B. MASSEY

Consulting Engineer, Chicago, Ill.

LEAD wires may be used to great advantage in adjusting the clearance for brasses on large bearings under heavy load. The bearings to which this method is most applicable on construction work are those of the main engines on hydraulic dredges, as other steam engines used in excavation work are usually of a rugged, steam-eating type with cranks set on the quarter, so as to avoid being caught on the dead center. In countries where coal is dear and labor is cheap, engineers are astonished at the amount of coal burned on American excavating machines, and would seem to prefer using less coal, at the expense of simplicity in construction and freedom from engine delays. The large engine on the standard American hydraulic dredge employed to drive the centrifugal pump, which ordinarily has a 20-in. discharge, is, however, usually of the vertical marine type, using steam economically by triple expansion, and exhausting into a marine-type surface condenser. On account of the large size of these engines—from 600 to 1000 hp.—there are large pressures to deal with on bearing and rod brasses. The cutoff on the high pressure is adjustable, and the same is often the case with the intermediate, so that the pressures on the bearings are apt to vary when working under different conditions. There are also bypasses to admit high-pressure steam into the intermediate and low-pressure cylinders. The adjustment of the bearing brasses throughout becomes a vital matter in the uninterrupted use of such an engine. As assistant engineer in the United States Navy, the writer made use of the navy method of adjusting large bearings, which can be employed on hydraulic dredges to insure continuity of bearing adjustments, independent of the coming and going of engineers.

The method employed is to take off the bearing caps and lay over the journal three strips of 1/16-in. lead wire parallel to each other, one at each end of the journal and one at the middle. The caps are then pulled down hard on the liners and the positions of the nuts tentatively marked. Taking off the caps, the wires are found to have been flattened, some at the top of the journal and more so at the sides. The thickness of the three wires is measured with a micrometer caliper. If the thickness is too great, the proper thickness of liners is removed and the same operation repeated until the wire thickness at the top of the journal is exactly right. The rule for the thickness of the lead wire is that it should show one-thousandth of an inch for each inch of diameter of the journal, where forced lubrication is used, but where wick feed is used, the clearance runs up to two-thousandths of an inch for each inch of diameter. Practice will show that for most shafts the proper clearance will lie between these two extremes, and by taking about 1 1/3 the diameter of the shaft expressed in thousandths good results should be had. For example, 0.012 is the proper thickness for a 9-in. shaft. This method is much more reliable than keeping tab on the liners, as they should vary with use. It also checks up on the alignment and substitutes a system for personal practice.

Dropping the Bucket to Unwind Worn Dragline Cable

AN EXCEEDINGLY simple kink which it is possible may not have occurred to many dragline operators is described by J. W. Knott in the *Excavating Engineer.* The drums on a large dragline engine do not roll easily by hand, and, especially if the fricton is tight, a bar must be used in taking off worn dragline cables unless the engine is a reversing one. Mr. Knott's solution is to hoist the bucket as high as it will go, throw in the dragline clutch and drop the bucket. This, of course, reverses the dragline drum, as well as the hoisting drum, and unwraps the dragline at a rapid rate. By repeating the operation two or three times, the old cable can be readily taken off.

Light, Strong Gin Pole Built Up of One-Inch Lumber

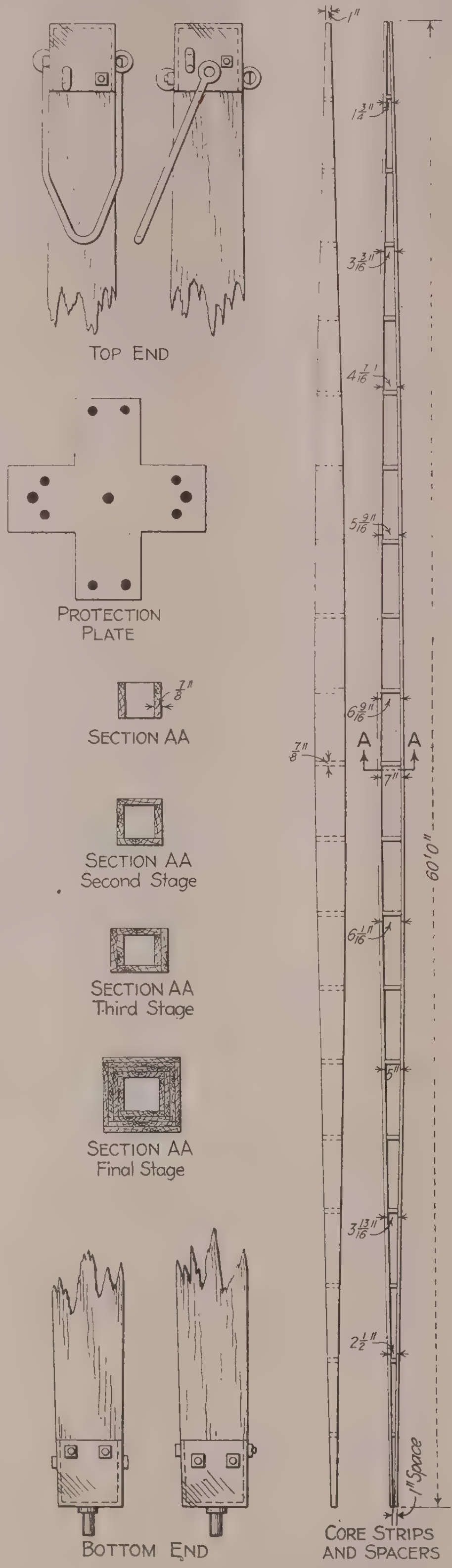
By MAX J. WELCH
New York City

FOR WORK in isolated localities the built-up gin pole illustrated in the accompanying drawing has been found very useful by contractors in the Rocky Mountain states. One of these poles, built five years ago by the writer, is still doing service in Colorado, having handled a great variety of loads on light erection work. Both Euler's and Rankine's formulas give the 60-ft. pole shown a safe loading in excess of 2 tons. The taper of the core was, however, figured by moments, which makes it evident that the same construction with different end connections would be an economical one for a derrick boom.

The core is made by nailing 7/8-in. boards in 20-ft. lengths to a series of square spacing blocks on 3-ft. centers, ranging from 1¾ in. square 3 ft. from the ends to 7 in. square in the center. The boards are then trimmed to a taper corresponding to the size of the blocks. Next, more boards are nailed in the same way to the open sides of this core, taking care to break joints with the first. These are also trimmed to the proper taper. This process is repeated until a thickness of four boards on all sides of the central hollow space is reached. The finished pole is then 14 in. square at the center and 8 in. square at the ends. Nailing should be thorough, using 8d nails for edge nailing and core blocks, 4d nails for two thicknesses of boards, 7d for three thicknesses and 10d for four thicknesses.

The ends of the pole are secured by ¼-in. steel plate. At the top eye bolts are provided for attaching the guys, while a steady pin may be fitted to the bottom.

This pole, which is practically equal in strength as a column to a 14 x 14-in. timber of the same length, weighs but little more than half as much. One can be built in a short time, and will pay for the increased labor cost over a single stick, even where the latter can be readily provided.



BUILT-UP POLE EASILY HANDLED AND STRONG AS TIMBER TWICE ITS WEIGHT

Back of Dam Coated by Cement Gun from Raft as Pool Rises

AS THE POOL rises behind the Elephant Butte dam waterproofing is being applied to its upstream face in horizontal strips 10 ft. high with a cement gun operated from a raft. The method was described in the March issue of the *Reclamation Record.*

The upstream face of the Elephant Butte Dam is being waterproofed with Portland cement mortar mixed in the proportion of one part cement to two parts sand and applied with a cement gun in a coating about 1 in. thick. Advantage has been taken of rising water in the reservoir to work from rafts specially constructed for the purpose. There are two of these, each 9 x 13 ft., made of planking on a framework laid on and attached to 16 oil barrels. One raft contains the machine, operator and helpers, small mixing box and a few sacks of cement and sand, while the other is loaded with cement and sand.

The coating is applied in horizontal strips about 10 ft. high and the length of the dam at water level. The surface is first cleaned thoroughly with scrapers and wire brushes and is then gone over with a sandblast, using coarse sand, passed through the machine to obtain the necessary pressure. This roughens the surface sufficiently to cause the mortar to adhere to it. The surface is then thoroughly moistened with a hose and the mortar immediately applied. The mortar is put on in four layers, each about one-fourth inch in thickness. It was found that a thicker coat than this applied on a vertical wall, without reinforcement, would, on account of its weight, slough off before setting. Each layer follows the preceding one before it has attained its final set, and so far there is no indication of a parting of the layers. Numerous samples taken from the face showed perfect adhesion to the concrete, it being impossible in every case to break the mortar from the concrete at the line of contact. The cost per square foot for the first 100,000 sq. ft. of this coating was 7.9 cents, including overhead and depreciation.

REINFORCEMENTS OF WOOD POLES with steel channels has proved to be very satisfactory for special terminal poles in the 15,000-volt transmission line of the Pacific Light & Power Corporation used by the Pacific Electric Railway near Los Angeles, Cal. Extra heavy wood poles 55 ft. long with top diameter not less than 9 in. were reinforced by two 6-in., 8-lb. channels, one on each strain side, with the channel flanges turned in, and extending the full length of the pole, connected by through ¾-in. bolts on 24-in. and 12-in. centers.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Track Elevation in Indianapolis This Year Will Cost $1,500,000

The program of track elevation work in Indianapolis this year will cost $1,500,000, it has just been announced. Pierce J. Landers, the new superintendent and chief engineer of the Indianapolis Union Railway Company, in company with B. J. T. Jeup, city engineer, has supervision of the general elevation project. The entire cost of the scheme will be $4,000,000.

Actual elevation of five tracks at the Union Station will begin late in March, according to the announcement. The elevation of the tracks between Capital Avenue and Meridian Street is contemplated before the close of the present year. In addition other preliminary work will be done so that early in 1917 the work can be pushed forward. The last link of the proposed elevation scheme is to be completed in 1918.

Plans now are being devised to allow the elevation work to go forward with the least possible hindrance to traffic. The first step in the plan is completed. This was the inclosure of Pogue's Run in a concrete conduit. The necessary concrete and steel footings to carry the elevated tracks at points of intersection were provided in connection with that work.

The construction of footings between Capitol Avenue and Meridian Street will be the first steps in the program for this year. The erection of the steel structure, now being planned to carry the tracks, with other steps involved, probably will run far into next winter. Actual changes in the present train sheds probably will come next year. The present sheds will be divided into halves, the south portion being elevated first. The north half will follow, and then the general elevation scheme will be continued eastward from Meridian Street toward Massachusetts Avenue, which will be the terminus of that part of the elevation plan. The old Illinois Street tunnel, under the present tracks at the Union Station, will be closed by the masonry work for one of the steel piers.

The actual bridge work of the elevation will appear only through the train sheds from Capitol Avenue to Meridian Street, and over the various street crossings from the latter street to Massachusetts Avenue. Between these street crossings a fill inclosed in concrete walls will be made, and the tracks thus elevated. Mr. Landers estimates that 10,000 carloads of fill material will be needed.

Engineers who have been designing the various phases of the work have provided for an archway where Illinois Street will pass beneath the tracks. This archway will be installed with an exterior facing of white glazed material. At the present time 21,726 tons of structural steel have been contracted for. The contract for the erection of the steel work will be let some time in May.

Denver Water Tangle Progresses Toward Municipal Ownership

Municipal ownership for the Denver waterworks appears nearer than for some time past, the Denver Union Water Company having recently given an option to the city officials and the Public Utility Commission to sell the plant at the "Chinn" valuation, subject to change by the Supreme Court. It will be two years before the city could take over the plant, even though the people vote favorably on the proposal to make the purchase. In view of these developments, bonds and stock of the company advanced during the first days of March.

Further, in a decision of the Wheeler-Lusk case, relative to the validity of the $8,000,000 bond issue for building a water plant, the U. S. Circuit Court of Appeals held the issue valid, although it stated in no uncertain terms that the issue was too small and that the duty of the Public Utility Commission and the city was to go back to the electors for authority to issue additional bonds. The court stated, however, that it had no power to compel such action.

Many Bidders at Vermilion County Highways Letting

Contractors from seventeen states, from Washington to New York and from Illinois to Louisiana, attended the lettings at Danville, Ill., March 14-16, for 170 miles brick and concrete roads in Vermilion County. A total of 220 contracts obtained specifications.

Many sand and gravel companies, and about 30 concrete road equipment companies had representatives at the lettings. Hotel scenes resembled those at the big road conventions.

Though, in some cases, the prices bid showed large differences between the totals of the high and low bidders the bidding was in general quite close.

To Offer Prizes for Designs of Workmen's Houses

The National Americanization Committee is offering prizes aggregating $1800 for plans, sketches, grouping and arrangements for small workmen's houses. This is part of the broad plans of the committee, which is endeavoring to secure the adoption of American standards by immigrants as rapidly as possible. A competition for designs for satisfactory substitutes for derailed freight cars now used to house construction gangs on railways is also part of the program.

The prizes are divided into two groups. The first covers plans for the housing of workmen in industrial communities not exceeding a population of 35,000. Entries in this class include plans for (1) single family houses, (2) combined family and lodging houses, which will permit separation of the families from the lodgers; and (3) boarding houses or community dwellings for numbers of single men or of single women. The prizes in this group are $1,000 for the first, $500 for the second, and $100 each for the third, fourth and fifth.

The prizes in the second group—covering substitutes for old cars now used by railway construction gangs—are $300, $200 and $100 for the first, second and third respectively.

The competition is open to engineers, architects and anyone interested in the subject. Details regarding it may be secured by addressing the committee at 20 West 34th Street, New York City.

Panama Canal to Be Open for Ships of 30-Ft. Draft, April 15

According to a cablegram received from Lieut.-Col. Chester Harding, Corps of Engineers, U. S. A., acting Governor of the Panama Canal, the canal will be open to ships of 30-ft. draft, April 15. The full text of the message is as follows:

"Conditions in Gaillard cut justify predictions that the canal will be available for ships of 30 ft. draft on April 15, subject to probable temporary delays thereafter to meet exigencies of dredging fleet in completing canal to full width and depth and in removing shoals that may possible develop."

U. S. Army Engineers Build Ponton Bridge in 14½ Minutes

Engineers who have been attending the weekly military lectures at the Engineering Societies Building, New York City, have been told repeatedly by the speakers that speed is the all-important factor in field work with an army. This statement was reduced to definite terms on Monday night when Capt. Stuart C. Godfrey, Corps of Engineers, U. S. Army, described how a ponton bridge of seven 20-ft. bays was constructed over a stream near Fort Leavenworth, Kan., in the remarkable time of 14½ min.

Following introductory remarks by Colonel Lucas of the 22nd Corps of Engineers, New York National Guard, Captain Godfrey discussed the subject of military roads, bridges and ferries. Road maintenance, rather than road building, is the chief concern of the army man, although occasions may arise when new traffic routes must be built. In new work the army engineer can use greater latitude in locating his road, and is justified in employing steeper grades, than the engineer in civil practice.

When streams must be crossed by armies the first thing for the engineer officer to do is to reconnoiter for a ford which will obviate the necessity of a bridge. For infantry, a depth of water of 3 or 4 ft. is about the limit, but cavalry can negotiate fords a foot or so deeper.

If no ford is available a bridge must be built. Captain Godfrey illustrated a large assortment of bridge types, including pontons, trestles, trusses and suspension bridges. The ponton train, he said, should not be used promiscuously, but should be held for a real emergency. In the United States service the wooden ponton boat is the standard type, but some of the European armies favor a metal boat. The Germans have employed an aluminum ponton.

Captain Godfrey concluded his address with a detailed account of the methods of military instruction in engineering practice at the United States Military Academy at West Point.

To Make Typhoid Elimination Survey of Indiana Summer Resorts

In a movement that will continue through several years in an effort to completely eradicate typhoid fever conditions at summer resorts on Indiana lakes and rivers, which have grown rapidly into prominence during recent years, the Indiana State Board of Health, through Dr. John N. Hurty, State health commissioner, has announced that the water department of the state board will conduct a sanitary survey of the resorts. Measures, looking toward better sanitation in many ways, including sewage disposal, proper construction of buildings, etc., will be taken by the state board, it is understood, wherever conditions warrant.

Michigan Agricultural Buildings Destroyed by Fire

The entire group of engineering buildings at the Michigan Agricultural College were destroyed by fire March 5. The loss is estimated at about $240,000 and the cause of the fire is unknown. Plans have been adopted for immediate reconstruction and classes have been re-established with practically no interruption. The most serious loss, it is reported, is that of records, notes and libraries of the teaching staff.

Chicago Issues New Rules for Sewer Trenching

Utilities in the space to be occupied by sewers in Chicago are subject to new rules recently put out in standard specifications by the board of local improvements of that city. The principal features of interest to contractors relate to trenches dug by excavating machines and are as follows:

Utilities in the way of trench machines of the steam-shovel type used to excavate for a sewer 3 ft. in diameter, or larger, must be removed and replaced without expense to the contractor. This diameter is reduced to 24 in. when machines of the endless-belt type are used. Below 24 in. the utility must be left in place and maintained at the expense of the contractor. Utility companies must take care of their lines when rock is to be blasted, provided five days' notice is given.

Where sewer trenches are excavated without the use of excavating machinery, except in rock, all utilities will be left in place and maintained at the expense of the contractor. A predetermined price per cubic foot of excavation, varying from 2 to 7 cents for depths from 6 to 24 ft., has been worked out for cases when the board deems it inadvisable to remove a utility.

In paved streets utility companies must replace disturbed pavement areas outside the limit of the sewer trench. The trench is defined as being the internal diameter plus 3 ft., when the wall of the sewer is 3 in. or less; 4 ft., when 6 in. and more than 3 in.; 5 ft., when 10 in. and more than 6 in.; 6 ft., when 16 in. and more than 10 in., and 7 ft. when the walls exceed 16 in.

Service lines, except water services, to buildings, must be removed without expense to the contractor on 48 hours notice, when excavating machines are used, also all interfering aerial equipment must be removed or altered. The latter, however, will not be removed to accommodate backfilling machinery, except at the expense of the contractor. Somewhat similar rules are in effect with reference to water mains.

Propose Drainage Section of Illinois Society of Engineers

Expansion of the work of the Illinois Society of Engineers to take care of drainage and levee interests by the establishment of a branch or section to include laymen as well as engineers, was the significant recommendation of the Drainage Conference held at the University of Illinois March 8, 9 and 10. The officers of the Illinois Society concurred in the action and it is likely that the formation of another engineers' organization has been averted.

More than seventy-five persons were registered at the conference; engineers, contractors, lawyers, levee and drainage commissioners and farmers. Most of the papers were not highly technical, but for the first time the Illinois engineer met the farmer in open conference and learned that the financial outcome of the whole proposition depends on the proper solution of the problems of soil texture and fertility of drained lands.

Paul Hansen, engineer of State Board of Health, outlined the relation of drainage to public health and stated that the functions of the new division of the board would be to approve and disapprove sewerage plans before contracts are awarded. The Rivers and Lakes Commission will, upon request only, review plans for drainage and levee works. Mr. Hansen gave a detailed description of the Mill Creek drainage improvement of overflow lands south of Louisville, where an expenditure of $390,000 increased land values to $3,000,000.

The paper by Jacob A. Harmon of Peoria, on "Organizing and Financing Drainage Districts," put into succinct form the methods used in the Middle West.

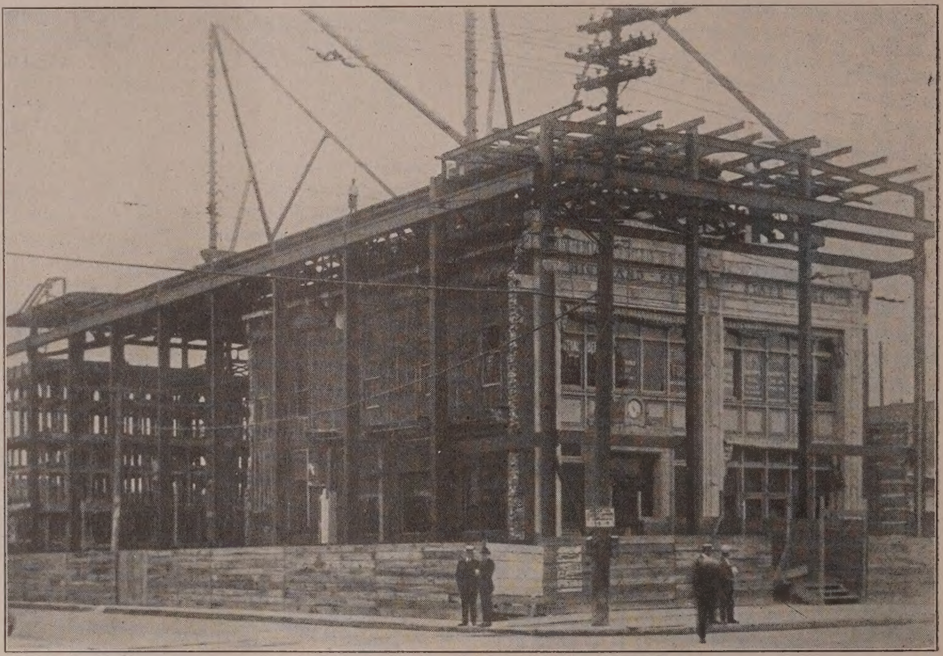
Prof. C. G. Hopkins, of the University of Illinois, rather startled his audience by his statements that many drainage propositions were foredoomed to failure because the lands, when drained, had not the chemical elements to produce crops. Settlement of muck in the Everglades, he claimed, might be as much as the proposed lowering of the water levels, in which case the land would be valueless. He stated further that a certain 600,000-acre drainage project extremely deficient in potassium, was being sold off. The real estate agents, in burning the timber and brush, release enough potassium for two or three crops and the land then becomes worthless. The unwise drainage and irrigation of unfertile areas should be guarded against in every possible way.

Prof. J. T. Stewart, of the University of Minnesota, stated that the time is fast disappearing when the engineer is told by the drainage commissioner where to locate his ditches and how deep to make them.

William A. O'Brien, of Cape Girardeau, Mo., in his talk on "Specifications for Drainage Districts," gave many valuable hints as to how to draw up specifications to fit the type of machinery to be used and thereby get economical results.

Prof. J. G. Mosier, of the University of Illinois, presented a paper on "The Relation of Drainage to Soil Texture," in which he brought out some points on the reasons why acid soils are hard to drain and why limestone increases percolation.

The university authorities were urged to consider another conference or short course for the diffusion of information on draining and flood protection.



DETROIT BANK ERECTS NEW STEEL-FRAME HOME AROUND OLD BUILDING

Old building on smaller plot was occupied until rear of new structure was ready for use, when quarters were moved, old bank was wrecked within the new building and latter was finished.

Engineers Suggest Reservoirs for Controlling Rio Grande River

Study of the problem of controlling the flow of the Rio Grande River and compelling its channel which forms part of the border between Mexico and the United States to remain unchanged, has resulted in the conclusion on the part of engineers familiar with conditions that reservoirs will best serve the purpose.

Col. C. S. Riche, of the government engineering forces at Galveston, after a study of the project reported as follows:

"The opinion seems to be general among the engineers and others of long experience with the Rio Grande, that reservoirs to control flood water in the tributaries will control the flow in the Rio Grande so that its variability will be almost unnoticeable, and the water can be supplied for irrigation at any time it is needed. Reservoirs would thus serve a double purpose.

Regulation and control of the river by open channel methods would only serve the single purpose of control of its variability of channel, nor is it likely that the river can be controlled by open channel methods at any reasonable cost."

E. B. Gore, of the Texas Board of Water Engineers, believes five impounding dams necessary. He would locate these dams on the Rio Grande, above the Pecos River and below the Conchos on the Pecos, on Devil's River, on the Rio Salado and on the Rio San Juan. This would insure ample water supply for 2,000,000 acres and develop not less than 80,000 hp. He claims that it is possible to develop 300,000 hp. with additional works.

John Wilson, also of the Texas Board of Water Engineers, concurs in the opinion expressed by Mr. Gore, while Clint Kearney, who helped build the Medina dam near San Antonio, recommends: (1) The construction of storage reservoirs to control and equalize the flow of the streams; (2) the installation of hydroelectric power plants, and the transmission of this power to San Antonio and other points; (3) the use of the water afterward for irrigation purposes.

The government has just issued a pamphlet on the Rio Grande question, which contains the opinions of Dan C. Kingman, formerly chief of engineers of the U. S. Army, and Col. W. W Harts of the U. S. Army together with detailed reports from the engineers just quoted.

Philadelphia Office of Concrete Institute Discontinued

The office of the American Concrete Institute, Philadelphia, has been permanently discontinued. Until further notice all business will be handled from the office of Leonard C. Wason, president of the institute, 27 School Street, Boston. This step was decided upon at the convention held Feb. 14-17, during the Cement Show at Chicago.

Canadian and International Good Roads Congress at Winnipeg in 1917

At a meeting of the Dominion Good Roads Association recently held at Montreal, it was decided to hold the 1917 convention of the Canadian and International Good Roads Congress at Winnipeg.

North Dakota Engineers' Society Meets at Grand Forks

The North Dakota Society of Engineers held its annual meeting at Grand Forks, N. D., Feb. 24 and 25. At the session held at the State University reports were made by Prof. A. J. Becker and others in the engineering department of the State University and tests of concrete materials and aggregates found in the state, and also of the effect upon these of freezing and of exposure to flue gases. Special attention was given to the possibilities of North Dakota clays for the manufacture of drain-tile, paving-brick, sewer-pipe, stoneware and pottery. Some of the clays of the state were said to have remarkable value for such purposes, on account of their purity, or because they do not require blending, and in some localities, lignite coal for use in manufacturing is found adjacent to the clay beds. E. J. Babcock, director of the mining experiment station of the state, exhibited specimens of commercial size, and stated that there was no doubt that pottery manufactures and other similar industries would be established in the state within a short time, as those engaged in the industry have recently begun to awaken to local possibilities. The operation of the waterworks plan at Fargo was discussed, and its costs detailed.

The sewage disposal plant which will be installed at Minot during the coming season was discussed. The Society approved for publication a code of ethics, nearly identical with that adopted two years ago by the American Society of Civil Engineers, and will urge the passage by the next Legislature of an act for the granting of licenses to public land surveyors, which has been prepared by it. This act will affect only surveyors who make plans or plats for filing with registers of deeds and similar certificates, and those holding the office of county surveyor. If surveys do not affect the title or ownership of lands or the filing or recording of plats, and if the surveyor is not holding a public office or acting in a similar private capacity, license will not be required. The officers elected for the coming year are: President, J. W. Bliss, state engineer; first vice-president, J. A. Ingram; second vice-president, H. C. Frahm; secretary-treasurer, E. F. Chandler. The next annual meeting will be held at Bismarck, at the end of January, 1917, during the session of the Legislature.

Indianapolis May Have Municipal Purchasing Agent

Mayor Joseph E. Bell has arranged for the employment of a purchasing agent for all departments of the city of Indianapolis, and has announced that he will ask the next Legislature to make provision for the employment of such an official in the laws affecting the charter of the city.

Chicago and Milwaukee Have Typhoid Epidemics

Recent reports from Milwaukee indicate that the city is suffering from a typhoid epidemic of no small proportions. Seven deaths and thirty new cases were reported Feb. 28, making 175 cases due, it is held, to drinking water. The supply to city schools was shut off Feb. 25, when the increase of more than ten a day was announced.

In Chicago, in the district furnished from the Hyde Park crib, consumers were warned to boil the water following a flood of Jan. 21, which backed sewage into the Sixty-eighth Street pumping station as described in these columns Jan. 29. By Feb. 22, eighteen new cases developed in the district served despite the precautions issued immediately to boil the water. On Feb. 3, the health commissioner stated that the water was good, but he reiterated the advice to boil it, Feb. 17.

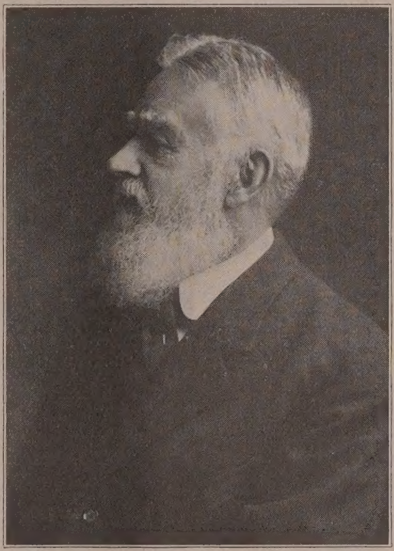
It is reported that the sterilization plant on the crib broke down from freezing pipes Jan. 11, and was not operated again until Feb. 15.

While the Chicago newspapers are carrying plenty of warning notices, the question is not discussed of the necessity of filtration in which a sterilization plant would be used only as an emergency or finishing process, for which it has so long been advocated.

Chicago's Oldest Surveyor Dies

Samuel S. Greeley, the oldest surveyor of Chicago, and the oldest living graduate of Harvard University, died in Chicago, March 8, at the age of ninety-two. Following his graduation in 1844 he was rodman and chainman on the waterworks being built under E. S. Cheseborough to supply Boston from Lake Cochituate. He then took a degree from Rensselaer Polytechnic Institute in 1845 after which he was employed as engineer in railroad location and construction in New York, Vermont and Virginia. In 1851 he studied engineering in Paris and in 1853 returned to Chicago and started the land surveying business which he continued, with one short interval, until his withdrawal from active work with the Greeley-Howard-Norlin Company a few months ago. In 1855 he was elected city surveyor of Chicago. He saw the advantages of a wood-block pavement, laid the first Nicholson blocks in Chicago and afterward invented a block pavement which was used to a limited extent.

Oldest Living Graduate of Harvard University, Who Died March 8



SAMUEL S. GREELEY

In the late sixties he became assistant superintendent of the Chicago, Burlington & Quincy Railroad, and, at the same time maintained his own private office. He, with four others, formed the Harvard Club of Chicago and was one of the early members of the Western Society of Engineers and the Illinois Society of Engineers. As a surveyor he located many of Chicago's most important buildings and laid out subdivisions which are now thickly populated parts of the city. In the early days he was concerned as expert witness in various important litigated cases in which Abraham Lincoln, Robert Ingersoll and other eminent lawyers were engaged. For many years prior to his death he ceased to do the more laborious work connected with his profession but continued, to give his time and attention to the business.

Even up to the last year of his life he was at his office daily and gave his associates the benefit of his counsel. He loved his work and was never happier than when engaged in it.

News of Engineering Societies

The Vermont Society of Engineers held its annual convention at Burlington March 9. Officers were elected as follows: President, H. M. McIntosh; vice-president, B. M. Hayward; secretary, G. A. Reed; treasurer, A. E. Winslow; director, F. W. Denison.

The Engineers' Club of Northeastern Pennsylvania, Scranton, heard a lecture on Thursday evening, March 16, by Captain Robert S. Thomas, Corps of Engineers, U. S. A., on the "Duties of a Military Engineer." This is one of a series of lectures scheduled by the preparedness committee of the club, headed by Capt. A. B. Dunning of Scranton as chairman.

The Municipal Engineers of the City of New York will hear Kingsley Martin, formerly commanding officer of the Second Battalion, Naval Militia, New York, on "Municipal Engineers and the Navy," and Ernest F. Robinson, captain of the Twenty-second Regiment, N. G. N. Y., on "Municipal Engineers and the Army" at a meeting to be held in New York City March 22.

The Western Society of Engineers was addressed March 13 by Malcolm Elliott, U. S. assistant engineer, Louisville, on "Large Modern Lock Gates." An innovation in the way of a brief review of the contents of the current issues of technical journals was presented by H. E. Hudson and W. W. DeBerard. Announcement has been made of future meetings as follows: March 20, "Panama Canal Slides," by Dean John F. Hayford; March 27, "Electric Vehicles," four fifteen-minute talks; April 3, "A Year's Operation of Panama Canal Locks," by Messrs. Clark and Whitehead; April 10, "Operating Machinery of Willamette River Bridge," by Byron Carter.

Personal Notes

FRANK H. ESCHRICH, formerly connected with the engineering force of the Delaware, Lackawanna & Western Railroad, has been appointed a layout engineer for the Samuel Austin & Son Company, constructing engineers, of Cleveland, on construction for the Hooker Electro Chemical Works of Niagara Falls, N. Y.

GEORGE K. PARSONS, consulting engineer, has located his main offices in the Equitable Building, 120 Broadway, New York City. Mr. Parsons also maintains offices in the Riggs Building, Washington, D. C.

ROSMAR S. DEVEREUX, formerly engaged in survey work in the Maine Woods on the Ripogenus Lake project for the Great Northern Paper Company, of Bangor, Me., has been appointed to a position in the repair and construction department of the civil engineer's office of S. D. Warren & Company, paper manufacturer, of Cumberland Mills Station, Me.

ROBERT A. KOERNER, civil engineer and architect, of Terre Haute, Ind., has moved his office from 2415 Sycamore Street to 30 South Sixth Street, that city.

J. F. REYNOLDS, formerly engaged in highway engineering at Storm Lake, Iowa, has become connected with the Trussed Concrete Steel Company on the design of reinforced-concrete buildings. He was graduated from Iowa State College in 1908 and served from then until 1913 as assistant engineer on the Oregon Short Line Railroad. From the latter year until 1914 he was engaged in reinforced-concrete work. He was on highway work at Storm Lake from then until the present.

R. L. WOOD has been appointed to a position on the engineering forces of the Missouri Pacific-Iron Mountain Railway at Monroe, La.

J. L. GOTSCHALL, formerly engaged in highway work in Morgan County, Ohio, has been appointed to a position on the engineering forces of the Interstate Commerce Commission, Division of Valuation, with headquarters at Chattanooga, Tenn.

Seth P. Burnett and F. F. Henige have formed the Burnett-Henige Construction Company, 116 North Washington Avenue, Saginaw, Mich., to engaged in a contracting business.

J. E. Greiner, consulting engineer, of Baltimore, has been appointed consulting engineer on the Market Street bridge across the Tennessee River at Chattanooga.

George M. Basford has resigned from his position as chief engineer of the railroad department of Joseph T. Ryerson & Son to become president of the Locomotive Feed Water Heater Company, a new $1,000,000 concern with offices at 30 Church Street, New York City. Mr. Basford will also form the G. N. Basford Company to handle the advertising account of a number of railway supply concerns.

George H. Bremner, assistant district engineer of Central District of the Division of Valuation, Interstate Commerce Commission, at Chicago, has been appointed district engineer for the same district, succeeding De Witt V. Moore. Mr. Bremner was graduated from the civil engineering department of the University of Iowa in 1883 and entered the service of the Chicago, St. Paul & Kansas City Railway as rodman. He spent a few months as transit man with the Chicago and Northwestern and later went to the Chicago, Burlington & Quincy to do work on a preliminary survey. From August to November, 1885, he was draftsman on construction for the Chicago, Burlington & Northern, and, from December, 1885, to April, 1889, he was division engineer of maintenance-of way for the Chicago, Burlington & Quincy. In April, 1889, he was transitman in charge of a party on location for the St. Louis, Keokuk & North Western (now a part of the Burlington System), on an extension from Old Monroe to St. Louis, Mo. In July, 1890, he was made assistant engineer on maintenance-of-way for the Chicago, Burlington & Quincy at Chicago, which position he held until June, 1902, when he was appointed engineer of the Illinois district of that road. November, 1904, found him in the position of engineer maintenance-of-way of the Illinois district, and in April, 1908, he was again engineer of the Illinois district, in which position he remained until his appointment to the Interstate Commerce Commission in February, 1914.

T. L. Higgs, formerly acting city engineer of Parkersburg, W. Va., was appointed city engineer, March 1, by a unanimous vote of the council.

E. G. Campbell has been appointed engineering superintendent for the Ohio State Highway Department at Pomeroy, to succeed W. A. Looker.

William C. Dunlop has been appointed assistant engineer with the Chicago Traction & Subway Commission.

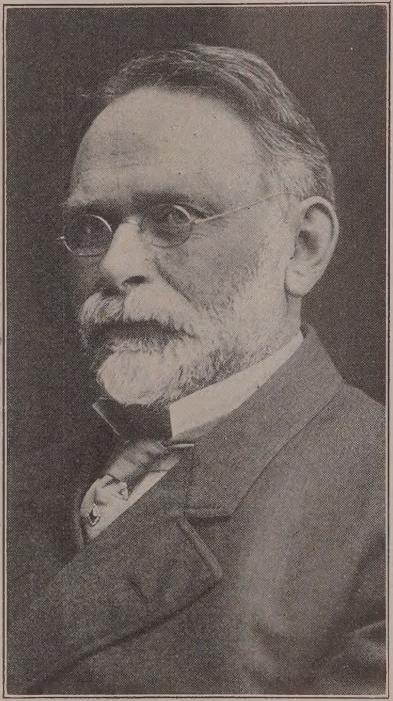
Walter A. Fischer, who has been engineer for the Western Water Company for the past four years, has again taken up contract work with the Valley Natural Gas Company, of Bakersfield, Cal. Mr. Fischer had four years' experience with the Western Water Company, and also spent ten years as a member of the firm of Glass & Fischer, who installed the sewer system at Albuquerque, N. M.

Ellis Soper of the Soper Engineering Company, of Chattanooga, Tenn., and formerly construction engineer on the Market Street bridge in that city, has been appointed chief engineer of design and construction of the plant of the Cuban Portland Cement Company at Havana, Cuba.

Charles S. Pope has accepted a position as engineer for the Warren Brothers Company of Oakland, Cal. Mr. Pope was formerly on the staff of the city engineer of Los Angeles, where he served for ten years, and rose from surveyor to a position where he was in charge of street work.

Reginald H. Thomson, for nearly 20 years city engineer of the city of Seattle, and who, since June, 1915, has been engaged in private practice in that city, was elected a member of the City Council on March 7. During his period as city engineer he made material changes in the topography of the city, removing great hills that it might extend and grow. Political precedents were broken when he agreed to enter the race for the council. In the campaign prior to the primary and general elections, he refused to address political gatherings and to debate or take any part in the preliminaries preceding an election. He made no campaign promises. When asked his platform, he invariably replied: "I will seriously consider each civic problem as it comes before the council and will vote the way my judgment tells me will be the most advantageous for the city of Seattle." His expenses for the entire campaign amounted to $40, three-quarters of which constituted the filing fee. Mr. Thomson went to Seattle in September, 1881, and entered into partnership with F. H. Whitworth. The firm, known as Whitworth & Thomson, engaged in engineering throughout the Northwest until 1888, when Mr. Thomson went to Spokane for a year on the Seattle, Lake Shore & Eastern Railway. He served the city of Seattle as surveyor from 1885 to 1886. Returning from Spokane in 1889, the engineering firm of Thomson & White was formed, which engaged in general engineering until May, 1892, when Mr. Thomson became city engineer, under Mayor Ronald. After nearly twenty consecutive years as city engineer, he resigned in November, 1911, to become chief engineer of the Port of Seattle. Early in 1912 he resigned from that office owing to litigation which threatened to indefinitely impede actual construction. He was immediately called by the Provincial Government of British Columbia to take charge of the work on the proposed new Strathcona Park on Vancouver Island, which covers 532,000 acres of land. At the outbreak of the European war, all public work in British Columbia was brought to a close, and Mr. Thomson returned to Seattle, where his present engineering offices in the Alaska Building were opened. On March 7 of the present year the county commissioners of Snohomish County at Everett, Wash., passed a resolution employing Mr. Thomson as consulting engineer for that county in the construction of roads provided for in the recent $1,800,000 bond issue. He has been asked to make a thorough inspection of all the roads to be paved, to become familiar with the situation and to advise the county on all matters in connection with the work, including the acceptance of bids.

Former City Engineer of Seattle Elected Member of City Council After Unusual Campaign



REGINALD H. THOMSON

H. A. Thomson, formerly attached to the Philadelphia office of the Pennsylvania State Highway Department, has been appointed engineer in charge of district 1 of the bureau of township highways.

Charles E. Parsons and Guy C. Simpson have organized the firm of Parsons & Simpson, with offices at 61 Broadway, New York City, and San Antonio, Tex., to engage in consulting practice, specializing in hydroelectric, irrigation, water supply, industrial, transportation and structural engineering and investigations, and reports on Mexican oil, mining and agricultural properties. Mr. Parsons, in addition to his consulting practice, is president of the Ambursen Hydraulic Construction Company. For ten years he was chief engineer of the Hudson River Power Company—now the Adirondack Electric Power Corporation—in which capacity he designed, constructed and operated the Haines Falls, Spiers Falls, Glen Falls, Utica, Ballston, Albany, Amsterdam, Troy and Schoharie power plants. He was also chief engineer, and one of the organizers of the Atlanta Power Company and the Georgia Railways Power Company. He was graduated from Union College in 1898. In 1899 he made a survey for a hydroelectric plant for the Hudson River Power Company and worked in the offices of William Barclay Parsons and H. de B. Parsons in New York City, on plans for the development of the plant. From 1900 to 1908 he was chief engineer of the power company. In 1908 he became a member of the firm of Hilliard & Parsons, consulting engineers, of Albany, N. Y. In June, 1909, he was made chief engineer of the Atlanta (Ga.) Power Company and, in 1911, he was put in charge of the purchase of lands and construction of substations and transmission lines for the Georgia Power Company. He was appointed second vice-president and consulting engineer with the Ambursen Hydraulic Construction Company in 1912, and subsequently became its president. Mr. Simpson was graduated from Massachusetts Institute of Technology in 1906 and served for a time on the three-track work of the Pennsylvania Railroad in Indiana and Ohio. Following this work he was for about five years with the Alberthaw Construction Company, the Eastern Construction Company, the Expanded Metal Company and Crom, Goodhue & Ferguson, architects, of Boston. As a contractor and construction engineer he built works to a value of about $2,000,000 in Louisiana, Texas and Tennessee. About four years ago he was with James A. McGonigle on the construction of Fort Crockett at Galveston, Tex. During the past three years he has been chief engineer of the Guadalupe Water Company of Texas, of which he was one of the organizers. His work during the past ten years has taken him frequently to Mexico and has given him an extensive knowledge of conditions in oil, mining and agricultural properties of that country.

E. H. Baldwin, acting chief of construction of the irrigation service, recently visited Phoenix, Ariz., to look over the project there in order to determine just what is needed since the flood damage. He was accompanied by W. S. Cone, manager of the local project, and L. N. McClellan, assistant electric engineer. A board consisting of a number of consulting engineers will go over the entire project, it is reported, to determine what steps will be necessary for making permanent repairs.